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ELECTRICAL WORLD

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J. M. FLANIGEN
Georgia Power Company

•

TRANSFORMER REACTIVE TESTS
G. A. COLLINS
San Joaquin Light & Power Corporation

•

SPHERE GAP AS REFERENCE STANDARD
P. L. BELLASCHI
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POWER COSTS IN WISCONSIN
B. J. SICKLER
Wisconsin Public Service Commission

•

PROGRESSIVE DISTRIBUTION DESIGN
MERRILL DE MERIT
Chairman E.E.I. Subcommittee on Distribution Costs

•

MOTOR DRIVES IN GARMENT FACTORY
REGINALD GORDON

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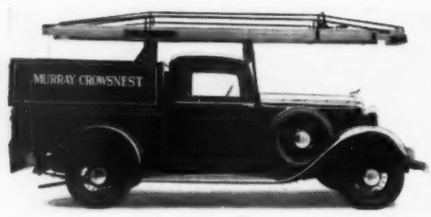

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ELECTRICAL WORLD

FOUNDED IN 1874 ● READ BY ELECTRICAL MEN FOR SIXTY YEARS

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Reader's Guide to This Issue

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THIS INDEX is merely a convenient guide. Many articles will appeal to several reader groups—many will apply to all. News and other departments are of general interest.

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He is Glad Those Bad Spots Were Wired with

OKOLAST

A TREE WIRE ARMORED WITH BRAKE-LINING

OKOLAST TREE WIRE will cut down the calls to the Trouble Desk, will make big savings in repair costs, and will prevent many interruptions to service. The winter and early spring, before the sap and foliage return, is a fine time to fix the "bad spots." But any time is a good time for installing OKOLAST—wherever shorts and grounds occur.

OKOLAST is a simply constructed tree wire. It has only **3** materials besides the conductor:

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OKONITE QUALITY CANNOT BE WRITTEN INTO A SPECIFICATION

. . . *Trends* . . .

As Gleaned From This Issue of "Electrical World"

▸▸Cost of Power

We have had the war scare about power shortage with the inference that therefore the government should build hydro plants. Poppycock! We are now fighting unemployment and not a war. All social and economic factors point to fuel-burning stations and not hydro stations.

Here are official data from the Wisconsin Commission showing costs of power in that state. They show what is already being done and that these values make it difficult to justify hydro developments. But many changes and new developments have occurred in the depression years. For new fuel stations designers and buyers can shoot at 4-mill busbar power and $75 per kilowatt unit cost. These costs can be bettered in many instances by remodeling old stations or by superimposing high-pressure units on old stations. With loads going up steadily there is going to be a revival of power station building. This should be based upon costs and a knowledge of present-day equipment and its possibilities.

▸▸Operating Data Pay

J. M. Flanigen, in this issue, shows how to use distribution data intelligently and effectively. It does little good to make maps and card inventories of distribution unless used in connection with service and equipment performance measures. Data collections are expensive and should be selective and purposeful. A life history of equipment with all costs involved tells some startling stories—the best being that it pays to buy quality products even though higher in first cost. Also, operating data show where to spend money to best advantage. They show where the weak links exist and what to do to fix them up. No utility is finished with its work until it has a plan for distribution and for distribution data collection and use so as to get the best service for a minimum expenditure. Incidentally, it also pays to know about and use some of the new and improved equipment developed for distribution. There have been great advances.

▸▸High Voltage and Reactive

Advances in the art are made when measurements become accurate. Many are dealing with high voltage and with impulse voltages. These must be measured. One of the standard devices is the sphere-gap, and Mr. Bellaschi gives us an interesting article and valuable data on this topic. This high-voltage field is fertile for the development and use of many new equipments and devices. In the same category is the article discussing reactive tests on transformers. We approach precision day by day, and this means economy and better quality.

▸▸Still They Come

Letters about our Recovery Issue continue to arrive. Those from legislators, governors and industry executives are particularly gratifying in that all are constructive and these men appreciated the information. In no case was there a letter attacking our data or our purpose and we gained a greater appreciation of the integrity and honesty of purpose of men in high places. The enemies of the utilities are but a vociferous minority.

E.E.I. Convention

Atlantic City, June 3-6

We plan two outstanding services:

1. An exhibit in print showing all new and improved devices developed during the depression years — Our Equipment Progress pre-convention, May 25, issue.

2. A complete report of the meeting in our Report Issue of June 6.

▸▸Industry in the Market

We just made a sample survey of industrial plants in one town and found that 50 per cent of them were going to buy electrical equipment this year and also most of these said they would consult with their utility power salesmen in connection with these purchases. This is a hint to manufacturers and power salesmen. They must know new equipment and new processes in order to aid the industrial plants in their purchasing and remodeling. We try to help. Two articles in this issue are cases in point. Motor drive in a garment factory has much of the "go thou and do likewise," and what better example of proved economy can be found than the experience story in which electric enameling proved so good that its application was extended. There is business available, but it takes new knowledge and a new technique to sell it. Engineers in industry and in power sales should be on their toes to take advantage of the recovery situation, even though the manufacturers are not yet fully awake to changed conditions.

▸▸Economy in Distribution

The E.E.I. committee on distribution is sponsoring a series of articles showing how to make the best of this expensive part of the system. Mr. De Merit clearly outlines the economic problem in this issue. The endeavor is to have a plan for distribution expansion to meet new load demands and new service standards. Hit-or-miss installations are wasteful and he coins a good phrase in "progressive distribution." New equipment is available and should be used intelligently and economically. There is going on now an expansion and replacement in distribution that is indicative of what may be expected in coming months. This committee is to be commended for contributing a very timely and valuable discussion to the reviving question of distribution economics.

Inside Facts about Outdoor Lighting

The Syracuse (N. Y.) Lighting Company is now installing 15 new sodium-vapor highway luminaires on an important New York State highway. This brings the number of units on this road to 25, all of them G-E. More than a mile of lighting—the longest stretch of golden highway in the country.

Radial-wave reflectors are now being manufactured of Alzak aluminum—a new product of the Aluminum Company of America. This aluminum, which is purified and hardened by an electric process, has a surface with slightly better reflecting qualities than porcelain enamel, and a durability that has surprised us all. Reflectors that have been exposed to the weather for many months are returned to almost their original efficiency simply by cleaning them. Several reflectors have been mounted along the coast, subjected to salt atmosphere, and so far have shown no signs of corrosion. Since the finish is an integral part of the reflector, all danger of cracking, chipping, or rusting is eliminated. G-E salesmen have complete information on these new reflectors.

A new, aluminum light shield, for use in any standard street-lighting globe, has just been designed by General Electric. Its price is considerably less than that of former shields. Install a few of these where you have residential complaints of glare from street lights—you'll find them to be just what you need.

Cut your Maintenance Costs with this G-E Suspension Luminaire

More than 1000 were bought in New England alone last year

THE G-E Form 72 suspension luminaire combines low maintenance with safety. It is designed for wiring with a duplex cable, which is carried externally to the porcelain insulator and in through a hooked entrance channel where it is split and fastened to the internal binding posts.

LOW MAINTENANCE . . . a direct result of fewer outages and fewer replacements of the porcelain insulator. The duplex cable is stronger than separate conductors; it practically eliminates grounds and short circuits. The porcelain is supported in such a way as to remove almost all strain that ordinarily causes breakage.

INCREASED SAFETY . . . a direct result of fewer grounds, assured by the strength and insulation of the duplex cable, and by the elimination of all external live parts.

This luminaire has many other advantages: it costs no more than ordinary suspension luminaires; it uses standard mountings, reflectors, and glassware. Write to Dept. 6Q-201, General Electric, Schenectady, N.Y., for a publication that describes the Form 72; or arrange, through your own local G-E office, to see it.

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GENERAL ELECTRIC

ELECTRICAL WORLD

MANAGEMENT • ENGINEERING • OPERATION • UTILIZATION
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APRIL 27, 1935

An Absurd Conclusion on Power

IN THE event of war we would have a power shortage. It is necessary, therefore, for the federal government to build hydro power stations. These are the conclusions made by the Federal Power Survey in a report that contains valuable data on power. The data do not support these conclusions. This is another piece of propaganda put out under federal auspices.

This country has 34,000,000 kw. in power stations, France has 8,000,000 kw., Germany has 13,000,000 kw., Great Britain has 10,000,000 kw. Looking at these data, we are the best prepared country in the world to wage war. Building power plants in anticipation of war is about as uneconomical and as sensible as building great munition plants to lie idle.

In the last war there was very little power shortage. Government orders were poured into one or two areas. These areas have since merged or interconnected their power resources so that the return of a world war peak of orders would cause no shortage in power. But the War Department now knows better how to do things. It has data on power resources. It has plans to place orders for war materials intelligently in the many industrial areas of this country. The War Department has issued no warning about a shortage in power capacity.

We are fighting a war on unemployment today. The plea that little labor is needed in operating hydro plants affords a sound reason why they should not be built at this time. They are the most expensive and least worth-while type of government project measured in terms of employment and economy in power production. The conclusions and inferences in this report are unsound and unwarranted.

Data in the report are valuable, although quite well known. We have surveyed the situation in the past year and have published data of about the same order of magnitude. If business keeps up, if industrial load returns, then we will need to install more generating capacity in the next year or two. We said last July that 3,500,000 kw. of additional power capacity would be needed to carry the recovery load when it came on the systems. But that load has not yet arrived.

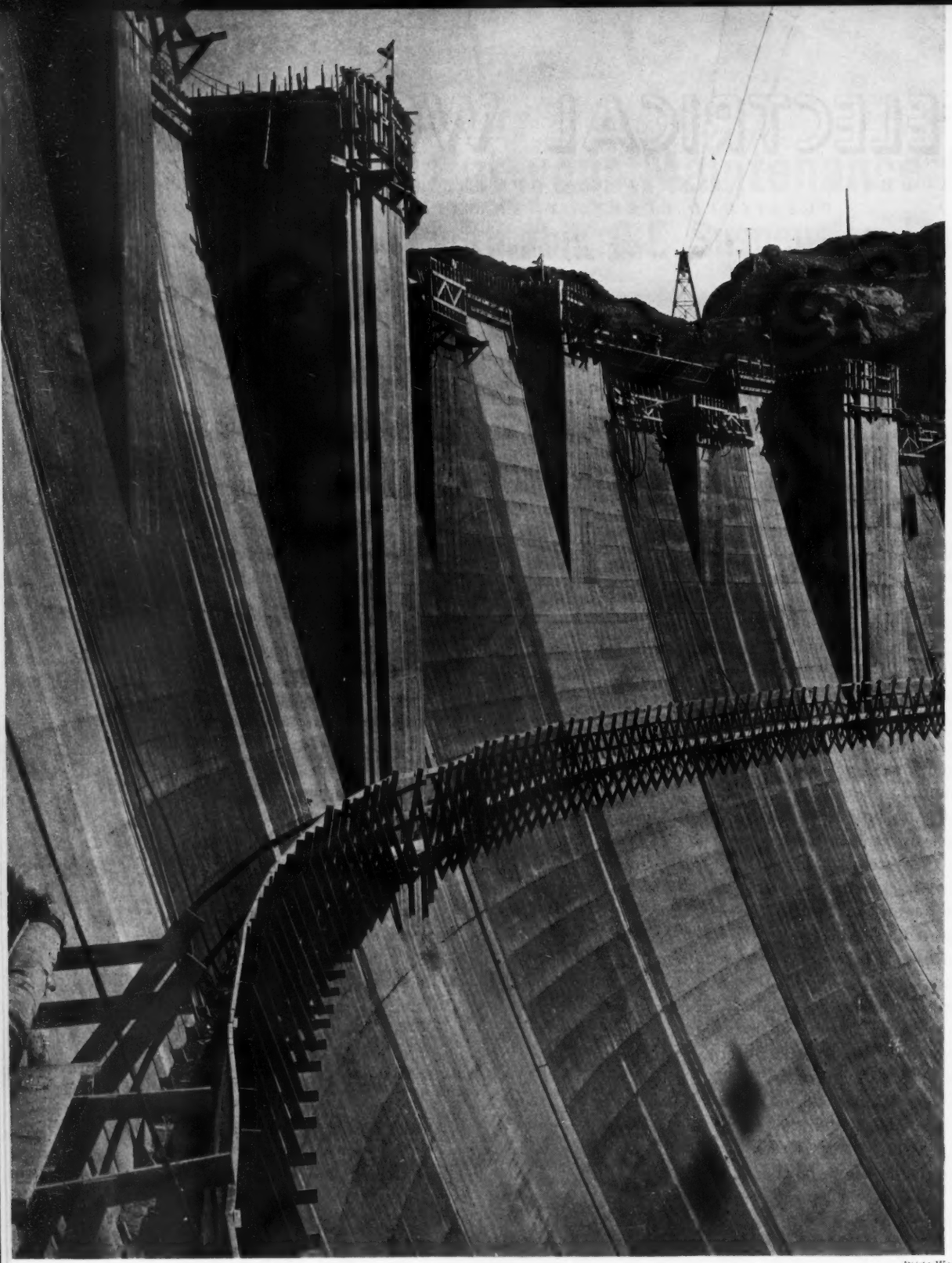
NEW capacity is available quickly in remodeling old stations. A great reserve of capacity lies in reducing the reactive loading of transmission systems by the use of synchronous condensers. Load factors will be greatly improved if and when recovery is here and expected peak values may no longer be measured on the basis of the past. Many stations that the Federal Power report says are obsolete are operable and are justified, particularly those that serve as standby reserves on extensive hydro or transmission systems. Power systems are interconnected today and emergency power can be thrown from region to region over great distances. It is fallacious to estimate hydro power on the basis of water shortage on all watersheds at the same time—this never has happened.

This industry knows the power business. It is well aware of the data in the Federal Power Survey. It is competent to handle the power supply of this country and to insure an adequate supply under every condition. It will build new stations, remodel old stations and increase power capacity in ample time to meet the needs. The War Department also knows its business.

There is little that is new in the Federal Power report. The inferences and conclusions are fallacious and can be explained only on the basis of an obvious attempt at propaganda to give support to federal power policies which are inimical to private enterprise.

Data on Power

Capacity in 1929 (kw.)	30,770,000
Output in 1929 (kw.-hr.)	91,421,000,000
Capacity in 1934 (kw.)	33,765,000
Output in 1934 (kw.-hr.)	85,610,000,000
Assuming same operating conditions, margin of capacity in 1934 (kw.)	4,000,000
Assuming same operating conditions and present loads, present margin of capacity (kw.)	2,415,000



Wide World

726 FEET TO BASE

From the depths of Black Canyon, where prospectors once roamed and an erratic river flowed in the gorge it had taken ages to cut, Boulder Dam now rears in massive height. From bedrock to crest it measures 726 ft. and contains nearly 7,000,000 tons of concrete. Capable of impounding 30,500,000 acre-ft. of water in a reservoir 115 miles long, the dam is primarily for flood control, water supply and irrigation, but electric power will be a by-product. The local plant will be rated at 1,835,000 hp. and have a firm capacity of 663,000 hp. An output of 4,330,000,000 kw.-hr., dependent on the market, will be available in 1937. Appropriations, voted, do not exceed $165,000,000.

Progressive Distribution

Distribution Costs Are Less When Designed at the Outset to Meet Progressive Growth

By MERRILL DeMERIT
Chairman of E.E.I. Subcommittee on Distribution Costs

This article is sponsored by the Edison Electric Institute subcommittee on distribution economics. The author is chairman. It is the first in a series which will lay a new guide for distribution building. Too much past installation failed to avoid oft-repeated replacement as loads outgrew facilities. The scheme here presented is not nonplussed by even a 1,500 per cent increase in load.

THE plan of distribution design described in this article is not a new, theoretical determination. It is based on technical studies made by men already experienced in distribution design in 1922 and 1923 and incorporated in the construction or reconstruction of more than fifteen distribution systems with modifications required by practical limitations found in the field. The advantages and adequacy of the systems have been checked from year to year by field tests and analyses of records and costs, its savings realized in the average distribution costs and reflected in the rates over a period of years of application of its principles to the progressive development of the same systems to provide adequate service to the increased and growing loads.

Most of the costs of distribution are proportional to the money invested in the distribution plant. As pointed out by analysts and authorities in several instances, and specifically by S. M. Dean at the E.E.I. convention in Chicago in 1933, "What almost every one engaged in the electric light and power business . . . fails to appreciate is the fact that some 80 cents of every dollar of gross income is spent for items proportional to investment, whereas only 20 cents is spent for items proportional to load." Mr. Dean was referring to system costs, but in distribution systems the proportion which varies with investment is greater than for the whole system, since in distribution there is no cost which varies directly with the load such as the cost of coal in system costs.

While there is a necessary variation of distribution costs in different locations and different systems, depending upon freight rates, character of soil, density of customers, consumption per customer. contour of street, and the like, the actual in a large part of all overhead distribution is equal to from one-third to three-quarters of the total cost of energy delivered to domestic and commercial customers. It is evident that the cost of energy delivered to a domestic lighting customer is largely dependent upon the investment in the distribution system.

Distribution cost defined

Distribution and distribution cost have been defined in so many ways that the term cannot be used without a definite statement of the meaning attributed to it in a specific instance. This article deals with that portion of distribution and distribution cost incurred in connection with that portion of the utility system which begins with the low-voltage bus in the substation and extends to the service entrance of the customer. This includes switches, regulators, primary lines or feeders, mains, branches, transformers and appurtenances, poles and fixtures, and services, but does not include subtransmission, substations or meters. The part of distribution cost as referred to in this article includes interest, taxes, depreciation or retirement, operating and maintenance costs, losses, and revamping costs, other than capital additions. It does not include meter reading and service costs, commercial and new-business costs, utilization, general administration and other general expense, nor the fixed charges nor operating costs on subtransmission, substations and meters.

With two or three notable exceptions, much that has been published on this subject consists of studies of economic balances of transformer spacing against secondary size under the assumption that the distribution load is static. The direct conclusions from such studies would lead to the installation of rather large secondary copper, a definite transformer spacing depending upon the starting densities of the load and with an allowance for 50 to 150 per cent overbuilding which would take care of the growing requirements for a period. At the end of that period it would be necessary to redesign the distribution and increase the size of the transformers and of the secondaries in accordance with a new economic balance. This is expensive, but much distribution has been designed on that basis.

Investigations in connection with revamping indicated that many of the accepted assumptions were wrong. One factor, for instance, is the cost of replacement of secondary wire. When secondaries are replaced all of the service must be transferred, which is quite an expensive and laborious job on every pole. Frequently many of the service wires will be spliced out and in many cases the cost of wrapping and incidental material substantially exceeded the value of the wire.

•

Progressive distribution design consists of a method or plan which enables the construction or reconstruction of a distribution system to provide adequate service along a street or in a section for the existing load on that street or in that section, with the elements so designed that if, when and as the load grows the system can be modified at minimum cost to provide adequate service for increased load.

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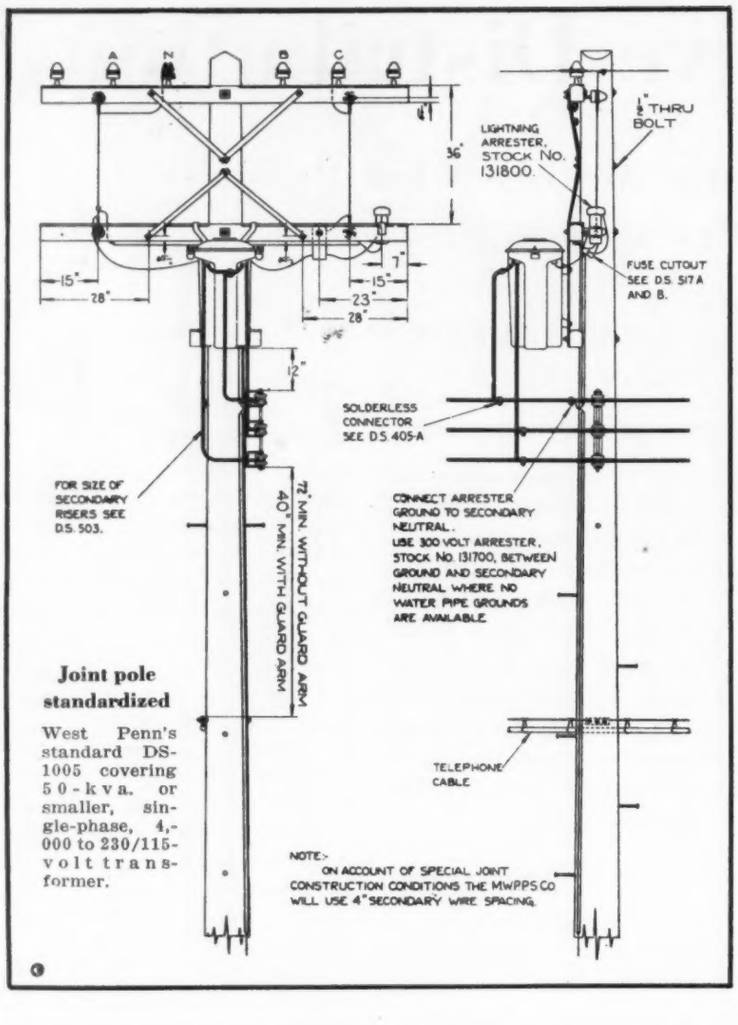
From the nature of distribution and the elements that go to make up distri-


A
N
B
C
41"
36"
LIGHTNING ARRESTER, STOCK NO. 131800.
½" THRU BOLT
FUSE CUTOUT SEE D.S. 517 A AND B.
7"
15"
28"
15"
23"
28"
12"
SOLDERLESS CONNECTOR SEE D.S. 405-A
FOR SIZE OF SECONDARY RISERS SEE D.S. 503.
72" MIN. WITHOUT GUARD ARM
40" MIN. WITH GUARD ARM
CONNECT ARRESTER GROUND TO SECONDARY NEUTRAL. USE 300 VOLT ARRESTER, STOCK NO. 131700, BETWEEN GROUND AND SECONDARY NEUTRAL WHERE NO WATER PIPE GROUNDS ARE AVAILABLE
TELEPHONE CABLE
NOTE:- ON ACCOUNT OF SPECIAL JOINT CONSTRUCTION CONDITIONS THE MWPPS CO WILL USE 4" SECONDARY WIRE SPACING.

Joint pole standardized

West Penn's standard DS-1005 covering 50-kva. or smaller, single-phase, 4,000 to 230/115-volt transformer.

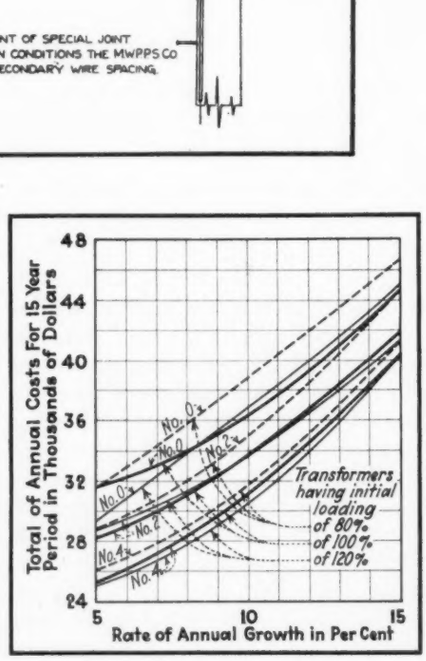
bution costs such a design must include the provision that additions to load may be taken care of by plant additions rather than replacements and that in the initial construction or in its succeeding steps of progressive development only inconsiderable excess capacities of poles, wires or transformers should be incorporated for future growth.

In the development of a system of progressive design a multitude of designs were made for a given section of territory incorporating severally the various assumed conditions, including different rates of growth for the period of the life of the plant. The cost for the entire period annually and per kilowatt-hour was determined for each of the different designs and for the same conditions of load and the most economical over the years selected.

In this investigation line type and "H" type distribution were considered, with primary voltages of 2,300 and 4,000 and with 230-115-volt secondary distribution, radial primary and secondary not banked nor looped; requirements of flicker and other voltage variations were recognized and the range of cost of material was such as to indicate that the conclusions would be the same regardless of variations within the range of probability. A study was worked out with the assumption that the life of the plant would be fifteen years and repeated with the assumption that due to outside conditions the period of life would be only eight years.

To take care of varying conditions the initial starting load densities were assumed to be 10 kva. per 1,000 ft. and 20 kva. per 1,000 ft. All studies were made for an annual growth in load of 5, 10 and 15 per cent. In the primary calculations Nos. 8, 6, 4, 2, 0, 2/0 and 4/0 B.& S. gage copper weatherproof wire were considered, but in the final calculations No. 8 was eliminated for practical reasons and Nos. 2/0 and 4/0 were excluded for obvious reasons of economy. Various factors like the ability of transformers to stand heavier loads at ambient temperatures were included in this consideration and the costs were worked out for all plans for transformers having initial loadings of 80, 100 and 120 per cent of capacity.

In a limited number of cases variations in the cost for energy were made, some being computed with transformer core losses at 3.5 mills and copper loss of secondaries and transformers at 7 mills. The same cases were worked out with the transformer core losses of 7 mills and copper losses at 14 mills. No wider range of costs was used, because it was evident from those calculations that a wide range could be used without affecting the conclusions.



Annual costs increase moderately with greater rate of growth

Total annual cost for a fifteen-year period for line secondary distribution. Maximum transformer loading 150 per cent. Maximum voltage drop 3 per cent. Life of plant fifteen years. Starting density 10 kva. per 1,000 ft. Iron losses (8,760 hours) at 7 mills per kilowatt-hour. Copper losses (1,095 hours) at 14 mills per kilowatt-hour. Size of wire for main sections designated on each curve. No. 4 wire used in all cases for short sections on side streets. Life of equipment for calculation of straight line depreciation; transformers, 30 years; wire, 15 years.

Progressive secondary design

Progressive distribution design may be exemplified by the secondary design in a hypothetical layout shown in the accompanying illustration. It involves the following features:

(a) Line type of distribution is used with the primary branches paralleling the secondary and with the primary mains generally at right angles to the secondaries as shown. The results may be somewhat different if the primary and/or secondary are looped, but the conclusions will be about the same.

(b) Transformer installations are constructed so that they can be applied to any pole without rearrangement of the equipment on the pole or the replacement with a larger or longer pole.

(c) Eventual transformer locations are selected initially for load density well above the maximum that can be anticipated; that is, about every 500 ft.

(d) Transformers are placed in the minimum number of the eventual locations to give the voltage regulation required with the load in existence at the time, with a minimum allowance for growth, and the size of each transformer is determined on the basis of the load to be served from the initial locations.

(e) No. 4 B.&S. gage copper secondaries are used on construction where the density of load is less than about 40 kw. per 1,000 ft. and No. 0 secondaries are used with higher initial densities.

(f) Only one change of secondaries is made from densities of 5 kw. per 1,000 ft. up to densities of 6,000 kw. per 1,000 ft., and this range covers practically all of the overhead distribution conditions which will be met with now or later.

If No. 6 wire is in place transformer spacings may be chosen somewhat closer together and the wire changed to No. 0 when the load reaches 25 to 30 kw. per 1,000 ft.

The same general method may be used with No. 3 or No. 2 B.& S. gage wire instead of No. 4, but will result in somewhat higher first cost and total cost over a period of years, except in systems having a general high load density such as that of companies operating in and around large metropolitan centers.

Among other things, this type of distribution eliminates:

1. Expense of replacement of secondaries.
2. Placing poles on many cross streets.
3. Excessive investment in oversized secondaries.
4. Considerable cost of placing transformers in new locations.
5. Makes a substantial saving in the engineering expense of determining the exact location and amount of the load when planning revamping, since only the general location of the load is important in the location of the transformers.

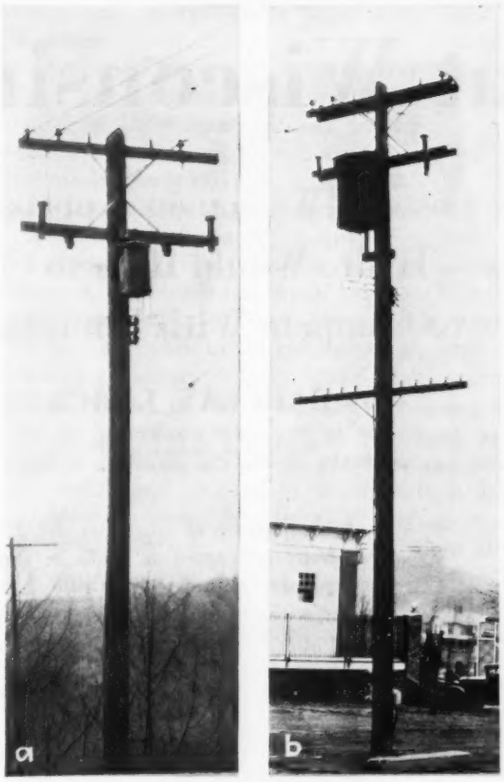
Intermediate transformers added

As the load increases over a period of years intermediate transformers of the same size as the original are installed at eventual locations and the secondary is sectionalized. Since the load is distributed from each transformer for half the distance the voltage drop and the secondary loss will be half of that of the original design. As the load increases further the transformers are replaced with transformers of double the capacity. The load going away from each transformer is twice as much as originally, but the distance is half as great, so that the secondary voltage drop and loss is the same as originally, although the load has increased 300 per cent. The same process can be repeated up to a total increase in load to 1,600 per cent of the original. The load growth is in different stages in different locations, and all steps of progression will be used at the same time; the transformers removed from one location can be used in another, avoiding a congestion of any one size.

One exception is made to the general principle that all increases in load are taken care of by additions rather than replacements, and this is in regard to the replacement of transformers with larger transformers during certain steps in the progressive development of the load and system. However, with the transformer locations predetermined and the type of construction adapted to this plan, transformers can be replaced without disturbing the other equipment on the pole. Primary and secondary connections can be opened and one transformer lifted off the pole and the other one and the five wires reconnected at inconsiderable expense and trouble.

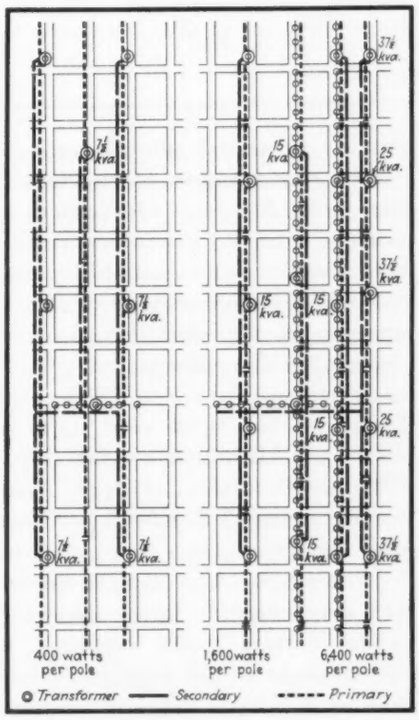
The accompanying illustration is of a section of regular streets to simplify presentation, but the principles have been applied to many of the very irregular sections of the towns in western Pennsylvania with about 90 per cent application in each case. This plan can be applied to any existing system when rehabilitation and increased capacity are required by making all changes in a way that will tend toward the system here indicated. All transformers of the old system can be used in the new; secondaries of No. 6 B.& S. gage copper or larger, regardless of size, can usually be left in place and resectionalized as transformers are added or replaced.

In the distribution systems to which this plan has been applied and which were overloaded when redesigned the capacity was increased more than 80 per cent and the voltage drop at customers reduced 75 per cent at a cost of about 15 per cent of the previous investment in primary and secondary wires, transformers, poles and fixtures.



Transformers replaceable without construction changes

(a) A 5-kva. transformer on a 35-ft. class 4 cedar pole with three No. 4 secondaries
(b) A 50-kva. unit on a 40-ft. class 4 pole with three No. 0 secondaries



System adapted to 1,500 per cent load increase

Minimum cost for low load density. Progressive development to serve sixteen-times increase, without changes in poles, primary or secondary wire. Transformers added or replaced. No other changes necessary.

Costs at Wisconsin Busbars

Busbar Energy Costs in Wisconsin Approach 4 Mills for Favorable Conditions—Hydro Would Have to Cost a Fourth Less Than It Has in Order to Compete With Dominant Plant at Milwaukee

By BARCLAY J. SICKLER
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STEAM-ELECTRIC energy generated in Wisconsin in the good water years of 1927-1928 constituted approximately half the total generated in the state, and in recent poor water years has reached as high a proportion as 62 per cent. The relative importance of each type of electric generation to the total is shown in the following table:

	Per Cent of Total Kw.-Hr. Generated		
	Steam Plants	Hydro Plants	Diesel Plants
1927	51.0	48.7	0.3
1928	49.9	49.8	0.3
1929	57.6	42.1	0.3
1930	61.9	37.7	0.4
1931	62.0	37.4	0.6
1932	58.2	41.1	0.7
1933	61.9	37.3	0.8

More than 90 per cent of the electricity generated by steam power in Wisconsin in 1933 was produced in five plants. One plant produced almost 70 per cent of the total generated in the state and two other plants generated about 8 per cent each. These five plants are listed as follows:

Name of Company	1933 Generation: Thousands of Kw.-Hr.	1933 Generation: Per Cent to Total for State
Milw. El. Ry. & Lt., Milwaukee (Lakeside)	748,935	69.1
Wisc. Pwr. & Lt., Sheboygan (Edgewater)	88,595	8.2
Wisc. Pub. Serv., Green Bay (Bayside)	80,128	7.4
Wisc.-Mich. Pwr., Appleton	36,174	3.4
Madison Gas & El., Madison	31,799	2.9
Total five plants	985,631	91.0
Total all Wisconsin steam-electric plants	1,083,557	100.0

The installed capacity of the above plants was only 73 per cent of the total installed capacity of Wisconsin steam-turbine-electric plants at December 31, 1933. The larger percentage to total of energy generated than of capacity indicates, of course, that these larger, more efficient plants are being used as much as possible, while other plants of interconnected systems are used only when required.

A comparison of costs per net kilowatt-hour generated in 1933 in these five plants is shown in Table I, together with certain other data to assist in comparing costs. Total operating expenses and maintenance per kilowatt-hour in this year ranged from 2.6 mills to 6.1 mills. Total costs, including fixed charges, varied from 6 mills per kilowatt-hour to 13 mills; about 7 mills difference. These differences are large in percentage, but minor in actual amount per kilowatt-hour.

The substantial differences between load factors and capacity factors in the different plants undoubtedly have material influences on the costs shown in Table I. In fact, fixed charges per kilowatt-hour are directly related to the capacity factor, being cut in half if the capacity factor is doubled. It seems probable that if all plants were operating at equal load and capacity factors, total costs per net kilowatt-hour generated would be about as follows:

	35 Per Cent Load and Capacity Factors	50 Per Cent Load and Capacity Factors
Milwaukee (Lakeside)	0.5 cent	0.4 cent
Sheboygan (Edgewater)	0.7	0.6
Green Bay (Bayside)	0.7	0.6
Appleton	0.8	0.7
Madison	0.8	0.7

To assist in interpreting the data on costs per kilowatt-hour generated shown in Table I some description of the operating conditions of the different plants should be provided. Three of the plants included in this study, namely, the Milwaukee, Sheboygan and Green Bay plants, are located on Lake Michigan. These plants, as well as the Appleton plant, located on Lake Winnebago, which has access to Lake Michigan, get their coal largely by lake boats. However, a coal dock has been constructed at the Green Bay plant, while in the case of the other plants coal is unloaded at coal companies' docks and shipped to the power plants by rail. In order to correct for this difference, coal costs at the Green Bay plant have been adjusted to the same cost per B.t.u. as at the Sheboygan plant. In the case of Madison all coal is shipped in by rail.

Milwaukee, Sheboygan, Green Bay and Appleton plants use pulverized fuel, while the Madison plant uses screenings.

Mostly base load operation

The methods of operating the five plants have certain similarities, but also have important differences. All of the plants, except Madison, are operated as base-load plants in periods

Out of impartial official sources comes confirmation of the belief that hydro has passed its peak and must be confined to projects which show best of water availability and lowest development costs. Critical analysis of the officially reported costs at the five ruling steam plants in Wisconsin show that 1933 costs ranged from 0.58 cent to 1.3 cents per kilowatt-hour for 300,000 to 30,000-kw. stations, load factors from 45.7 to 30.8 per cent and capacity factors from 45.7 to 12.1 per cent. Adjusting to the 50 per cent capacity factor expected when output really resumes, a hydro plant would have to cost as low as $155 per kilowatt to compete with the 4-mill energy cost. Existing hydros in that state are book valued at one-third more than that.

when water to run hydro-electric plants is low. In periods of high water the output of these plants is reduced to supply only the generating needs in excess of hydro-electric capacity. The chief difference between the methods of operating these four plants arises in the extent to which production is reduced in high-water periods. In the case of the Madison plant, however, the steam plant is used to meet demands in excess of a fixed amount of hydro-electric power available under contract. About half the capacity of this plant is used for standby purposes.

The following table compares 1933 capacity factors in the different plants in periods of high water and other periods:

	Per Cent			
	Jan. and Feb.	March-June, Inc.	July-Dec., Inc.	Annual
Milwaukee (Lakeside)	27.8	22.3	30.9	27.5
Sheboygan (Edgewater)	36.8	8.3	49.6	33.7
Green Bay (Bayside)	43.8	12.2	68.6	45.7
Appleton	19.8	7.2	29.9	20.6
Madison	12.8	11.8	12.1	12.1

It should be mentioned that the Sheboygan (Edgewater) plant was designed to have eventually a total capacity of 60,000 kw., although presently installed capacity is only half this amount. Cost of this plant per kilowatt is thus considerably larger than if the plant had been designed for the capacity now installed.

In computing unit costs, net kilowatt-hours generated were used; that is, station uses and losses were deducted from gross output. Actually, experienced operating expenses and maintenance in 1933 were used. Taxes were taken at 2 per cent of the book cost of plant and equipment, and interest was computed at 6 per cent. These arbitrary percentages ignore the actual experience of the companies, which varies from year to year, and between companies. In the case of depreciation expense also, the allowance used has been computed, rather than taking the amounts actually accrued by the companies. The amounts allowed were based on the following service lives, assuming no net salvage, and using the sinking fund method with a 5 per cent rate on accumulations: Structures, 66.7 years; boiler plant equipment, 20 years; turbo-generators, 25 years; electric plant, 25 years, and miscellaneous equipment, 20 years.

The use of assumed percentages for fixed charges reduces the number of variables in comparing costs in the different plants, and for this reason is believed to be preferable to actual experience. Many of the factors affecting actual experience of the companies with respect to these charges, such as their capital structures, credit ratings, and depreciation policies, have very little relationship to the efficiencies of their generating plants. Under the methods used in this study, the only factors affecting comparative fixed charges per kilowatt-hour generated are the respective costs of plant per kilowatt of capacity and the respective capacity factors.

Only costs to busbar taken

It should be cautioned that the costs shown in this article are simply generating costs and include nothing for substation, transmission, distribution, commercial, general and other costs. Nothing has been allowed for line losses, which will average from 10 to 15 per cent. Furthermore, the costs shown are generating costs in single plants only, not system generating costs. Other plants on the systems used to carry peak loads or for standby purposes necessarily have higher costs. These must be considered in determining system costs of generation.

The data used in this study were taken from the annual reports of the companies concerned to the Public Service Commission of Wisconsin, except in the case of book values of certain of the plants, which were obtained directly from the companies.

Hydro must better 4 mills

In view of the current enthusiasm for hydro-electric power, even under Wisconsin conditions, this article may well close with a digression on the costs which must be attained in hydro-electric developments if these are to produce at lower costs than the existing steam plants in Wisconsin. As noted previously, it appears that the Lakeside plant in Milwaukee could probably produce at a total cost of 4 mills per kilowatt-hour if operated at 50 per cent load and capacity factors. Under favorable developments of the market for electricity, such operating conditions would probably result. The existing larger hydro-electric plants in Wisconsin, which are typically operated to deliver all the power possible under existing water conditions, have average operating and maintenance costs of about 1 mill per kilowatt-hour.

Using this cost then, fixed charges must not exceed 3 mills per kilowatt-hour if a hydro-electric plant operating at 50 per cent capacity factor is to deliver power to Milwaukee as cheaply as the Lakeside plant could. A plant operating at 50 per cent capacity factor would produce annually 4,380 kw.-hr. per kilowatt of capacity. This figure times 3 mills equals $13.14, which is the amount which would be available to cover fixed charges per kilowatt of capacity on the investment in hydro-electric generating

Table I—Costs per Net Kilowatt-Hour Generated in the Five Largest Wisconsin Steam-Electric Generating Plants, 1933

	Milwaukee (Lakeside)	Sheboygan (Edgewater)	Green Bay (Bayside)	Appleton	Madison
Operating expenses per kw.-hr.:					
Fuel (cents)	0.20	0.23	0.26[1]	0.44	0.46
Other operation (cents)	0.04	0.06	0.07	0.09	0.09
Maintenance (cents)	0.02	0.01	0.02	0.03	0.06
Total (cents)	0.26	0.30	0.35	0.56	0.61
Fixed charges per kw.-hr. (cents)	0.32	0.43	0.28	0.53	0.69
Total cost per kw.-hr. (cents)	0.58	0.73	0.63	1.09	1.30
Pounds of coal per kw.-hr.	1.04	1.10	1.28	2.15	2.45
B.t.u. per kw.-hr.	13,300	16,000	18,000	28,200	29,200
Load factor (per cent)	45.7	33.1	45.7	24.0	30.8
Capacity factor (annual, per cent)	27.5	33.7	45.7	20.6	12.1
Installed capacity in kw.	310,800	30,000	20,000	20,000	30,000
Net kw.-hr. generated	748,900,000	88,600,000	80,100,000	36,200,000	31,800,000[2]
Book costs of plant per kw. of present installed capacity	$79	$129	$117	$94	$70

[1]Adjusted to the same cost of coal per B.t.u. as at the Sheboygan plant. [2]Based partly on estimated data.

plant and in transmission lines to bring the power to Milwaukee. Capitalizing $13.14 at 8½ per cent (interest 6 per cent, taxes 2 per cent, depreciation one-half of 1 per cent—based on 50-year life, no salvage, and a 5 per cent sinking fund), a "competitive" cost of $155 per kilowatt of capacity results.

If 35 per cent capacity factor is assumed, the "competitive" cost per kilowatt of capacity in a hydro-electric plant would be $145. The book value of most of the existing hydro-electric plants in Wisconsin averages in excess of $200 per kilowatt of installed capacity. This figure covers only the generating plant costs, not including anything for transmission lines to reach a market for the power.

It thus appears that, even disregarding the unreliability of water power, due to the occurrence of dry years, and the seasonal character of such power, probably no large hydro-electric development in the state could deliver power as cheaply to Milwaukee as could the Lakeside plant, assuming both plants operated at equal capacity factors.

Excessive? Look at France

Critics who argue that investment charges in the electric light and power industry are too high will probably refrain from quoting French statistics on this subject.

The U. S. Census of the industry for 1932 reports that fixed capital of commercial companies in this country was about $12,125,000,000; aggregate generator rating was 32,647,578 kw. The average is $372 per kilowatt.

In France, according to an item in Electrical Foreign Trade Notes, issued by the Department of Commerce, it is estimated that to make 1 kw. of electricity available to the public an investment of 10,000 francs is required. In terms of present parity between the respective monetary units this is equivalent to $663. Thus the French book value is 75 per cent higher than the American.

Transformer

Standard Technique for Voltage Transformers Adapted to Those Used for Quadrature Kva.

PHASING transformers used in metering reactive kva. can be tested for voltage ratio and phase-angle error by any of the methods used in testing potential transformers. The additional equipment necessary is a set of standard phasing transformers having separate primary windings instead of the usual auto-transformer arrangement.

A complete test on the service phasing transformers gives, on both phase sequences, the ratio correction factor and the phase-angle error of the two meter circuits *AB* and *CD* (Fig. 1). The time required is about five minutes.

Referring to Fig. 1, S_1 is opened, S_2 and S_3 are closed to the right. S_1 is then closed to the side which gives phase sequence *E-F-G* at the terminals *EFG* of the standard phasing transformers and the usual ratio and phase-angle adjustments are made with the test set. The ratio correction factor and phase-angle error of the meter circuit *AB* are, respectively, $X \times K_1$ and $Y + Y_1$, in which X is the reading of the ratio dial and Y the reading of the phase-angle dial of the test set. K_1 and Y_1 are factors depending on the constants of the standard phasing transformers and the phase sequence. To obtain the ratio correction factor and phase-angle error of meter circuit *CD*, S_1 is opened, S_2 and S_3 closed to the left, S_1 closed to the same side as previously, in order to keep the same phase sequence and the set again balanced for ratio and phase-angle measurements. The correction factor for meter circuit *CD* is $X \times K_2$ and the phase-angle error $Y + Y_2$.

Characteristics of the phasing transformer on the opposite phase sequence (*G-F-E*) are obtained by repeating the tests with switch S_1 to the side opposite of that used in the first set of tests. The voltage correction factor for meter circuit *AB* is $X \times K_3$ and the phase-angle error $Y + Y_3$, and that for meter circuit *CD*, $X \times K_4$ and $Y + Y_4$. To avoid damage to the galvanometer of the test set it is important that S_1 always be open when S_2 and S_3 are opened and closed.

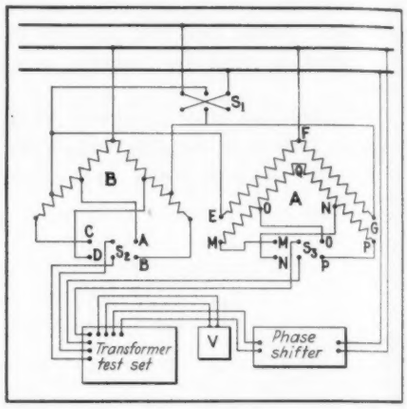

Fig. 1—Potential transformer set for testing 3-phase, 3-wire phasing transformers

Fig. 1 shows a test set-up using the Leeds & Northrup potential transformer set for testing three-phase, three-wire phasing transformers. In this figure, *A* represents the two standard phasing transformers, *B* the two service phasing transformers, S_1 a double-pole, double-throw switch for reversing the phase sequence applied to the phasing transformers, S_2 and S_3 double-pole, double-throw switches for applying first one meter circuit of the phasing transformer and then the other to the test set, *PS* a phase shifter and *T* the Leeds & Northrup test set. *CD* in one meter circuit of the service phasing transformer and *AB* the other.

Derivations of the constants K_1, K_2, K_3, K_4 and Y_1, Y_2, Y_3, Y_4 are given in the following description of the calibration of the standard phasing transformers:

Calibration of standard phasing transformers

To calibrate (see Fig. 2a) the standard phasing transformer, R_D is set at its maximum value of two megohms, S_3 is opened, S_1 and S_2 are closed to the left and the primary of the transformer, 1–2, is energized at 110 volts. The phase shifter is rotated until the galvanometer shows zero deflection. S_2 is closed to the right, the potential to the field of the galvanometer is shifted 90 deg. and the decade boxes R_A and R_B are adjusted to bring the galvanometer reading to zero. At the

Reactive Tests

By G. A. COLLINS
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Wherever refinement in determining power factor or kva. demand is expected the phasing transformers should be tested for ratio and phase angle. This is too often ignored. This article tells how the familiar procedure for potential transformers can be extended to the phasing transformers.

same time R_C and R_D are gradually decreased until they are both zero, when the final balance is reached. The ratio between the secondary $E_{3\text{-}5}$ and the primary $E_{1\text{-}2}$ is

$$\frac{E_{3-5}}{E_{1-2}} = \frac{R_A + R_B}{R_A}$$

Without disturbing the adjustment of R_A and R_B, S_4 is closed, S_1 closed to the left, R_C set at 10,000 ohms, and the potential to the field of the galvanometer shifted 90 deg. R_C is adjusted until the galvanometer reads full scale or gives maximum deflection. Its reading is recorded. S_2 is closed to the right and the galvanometer reading again noted. Calling the first reading N_1 and the second N_2, the phase difference, e, of $E_{1\text{-}2}$ and $E_{2\text{-}5}$ is

$$\tan^{-1} \frac{K\left(\frac{R_A R_B}{R_A + R_B} + R_C\right)\left(\frac{N_1 + N_2}{2}\right)}{E_{1-2}}$$

in which K is the current in amperes per division of the galvanometer scale. To determine the sign of the phase angle, S_3 is closed momentarily; if the galvanometer deflection is increased $E_{3\text{-}5}$ leads $E_{1\text{-}2}$ and the angle, e, is called positive. If the galvanometer reading is decreased or reversed the phase angle is negative.

In a similar manner, with a slightly different hook-up (2*b*), the ratio of $E_{3\text{-}4}$ to $E_{1\text{-}2}$ is found to be

$$\frac{R_A}{R_A + R_B}$$

and the phase-angle difference, b, between $E_{3\text{-}4}$ and $E_{1\text{-}2}$ equals

$$\tan^{-1} \frac{K\left(R_B + R_C + \frac{R_B R_C}{R_A}\right)\left(\frac{N_1 + N_2}{2}\right)}{E_{1-2}}$$

These two tests just described are made on each of the two standard phasing transformers. In deriving the constants K_1, K_2, K_3, K_4 and Y_1, Y_2, Y_3, Y_4, let

$$a = \text{ratio}\frac{E_{MQ}}{E_{EF}}\text{(Fig. 1)}\left(\frac{R_A + R_B}{R_A}\text{Fig. 2a}\right)$$

$$b = \text{ratio}\frac{E_{NQ}}{E_{GF}}\text{(Fig. 1)}\left(\frac{R_A}{R_A + R_B}\text{Fig. 2b}\right)$$

$$c = \text{ratio}\frac{E_{PQ}}{E_{GF}}\text{(Fig. 1)}\left(\frac{R_A + R_B}{R_A}\text{Fig. 2a}\right)$$

$$d = \text{ratio}\frac{E_{OQ}}{E_{EF}}\text{(Fig. 1)}\left(\frac{R_A}{R_A + R_B}\text{Fig. 2b}\right)$$

e = the small angle by which E_{MQ} leads or lags E_{EF}
f = the small angle by which E_{OQ} leads or lags E_{EF}
g = the small angle by which E_{PQ} leads or lags E_{GF}
h = the small angle by which E_{NQ} leads or lags E_{GF}

then

$$K_1 = [c^2 + d^2 + 2cd\cos(120° + f - g)]^{-\frac{1}{2}}$$
$$K_2 = [a^2 + b^2 + 2ab\cos(120° + e - h)]^{-\frac{1}{2}}$$
$$K_3 = [c^2 + d^2 + 2cd\cos(120° + g - f)]^{-\frac{1}{2}}$$
$$K_4 = [a^2 + b^2 + 2ab\cos(120° + h - e)]^{-\frac{1}{2}}$$

and

$$Y_1 = g + \cos^{-1}\left[\frac{1}{2cK_1} + \frac{K_1}{2c}(c^2 - d^2)\right] - 30°$$

$$Y_2 = e + 30° - \cos^{-1}\left[\frac{1}{2aK_2} + \frac{K_2}{2a}(a^2 - b^2)\right]$$

$$Y_3 = g + 30° - \cos^{-1}\left[\frac{1}{2cK_3} + \frac{K_3}{2c}(c^2 - d^2)\right]$$

$$Y_4 = e + \cos^{-1}\left[\frac{1}{2aK_4} + \frac{K_4}{2a}(a^2 - b^2)\right] - 30°$$

As previously indicated, K_1, K_2, Y_1, Y_2 are used when the phase sequence is *E-F-G* at the standard phasing transformers (Fig. 1) and K_3, K_4, Y_3, Y_4 when the sequence is *G-F-E*.

In a pair of carefully designed standard phasing transformers the phase angles Y_1, Y_2, Y_3, Y_4 can be made so small as to be negligible and the factors K_1, K_2, K_3, K_4 to approach the value 1 so closely that this figure can be used in testing the service phasing transformers.

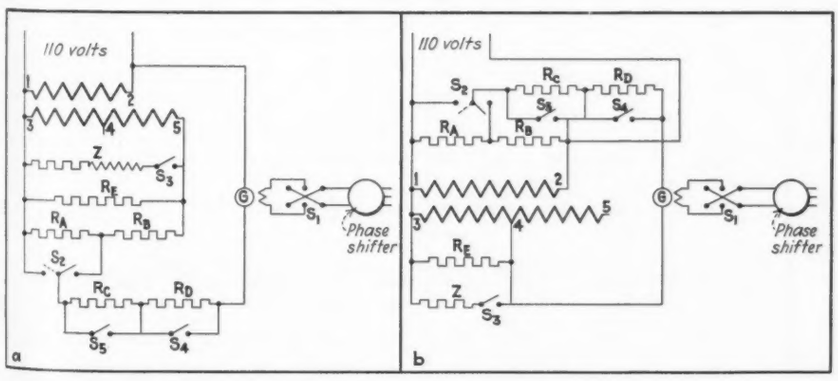


Fig. 2—Determining ratio, phase-angle and calibration constants of phasing transformer

(a) Set-up for finding the ratio of the full secondary E_{3-5}, to the primary E_{1-2}, and the small angle by which these two voltages differ in phase. (b) Similar set-up for finding the ratio of E_{3-4}, the secondary, to E_{1-2}, the primary, and the phase-angle difference. In both (a) and (b) *G* is a zero center moving coil galvanometer with separately excited field. R_A and R_B are two decade resistance boxes having equal time constants. R_C is a 10,000-ohm adjustable resistance. R_D is a two-megohm resistance adjustable in several steps. In (a) R_B is an impedance which in parallel with $R_A + R_B$ imposes a burden on the secondary of the transformer equal to that of the standard circuit of the apparatus used later in testing the service reactiformers. In (b) R_B alone is used to draw current from the transformer equal to that taken by the standard circuit of the test set. *Z* is the potential coil of a watt-hour meter used to determine the sign of the phase angle.

Operating Data That Pay

How Much Is Economical—Making It Easy to Collect Figures—Some Valuable Uses

By J. M. FLANIGEN
Assistant Superintendent Retail Operations
Georgia Power Company

CAREFUL STUDY of the operations of a distribution system will reveal many possibilities of improved service, lower operating expense and a more economical design for new work. In order to make such a study it is necessary to have reliable data.

In making any analysis there is a point beyond which the cost of obtaining the data is more than the economies obtained. On the other hand, a certain amount of data can be had for a relatively small expenditure and the information used to economical advantage. Just where this point of balance is it is impossible to say generally. It must be determined by experience.

Furthermore, it is necessary to get the proper amount of data from available sources without provoking the human element to the point of turning in unreliable data. For instance, if it is necessary for a foreman to carry a stop watch and clerk to record the information requested, he will either neglect his regular job or turn in false information. A happy medium must be struck whereby reliable information may be obtained and the data so collected studied and applied to yield good dividends.

In all phases of the operations some information is readily available. It is

[*Continued on page 34*]

Equipment-failure reports on transformers and lightning arresters are developed from such reports as Fig. 1 used to record changes in transformers. Examples of the information obtained from such reports are shown in Figs. 2 and 3a and b. They provide very good evidence of experience obtained with equipment of each manufacturer, and indicate conditions under which it must operate.

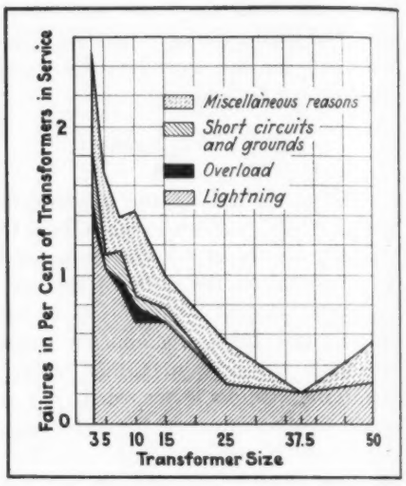


Fig. 2—Percentage of transformers failing from four causes

Refers to 2,300-volt transformers during 1933. Total failures in per cent of all sizes, grouped by cause, are: Lightning, 0.86 per cent; shorts, 0.41 per cent; overloads, 0.04 per cent; miscellaneous, 0.41 per cent; all causes, 1.45 per cent.

REPORT OF TRANSFORMER CHANGE

Town ..... District .....

Transformer Location No. ..... Division .....

	TRANSFORMERS SET			TRANSFORMERS REMOVED		
Co. No.						
Size						
Make						
Serial No.*						
Type						
Prim. V.						
Sec. V.						

Voltage Readings .....

Reason for Change: New Business ..... Rearrangement ..... Failure .....

Order No. ..... Account No. .....

If Failure, Check Reason: Lightning ..... Overload .....

Other .....

Extent of Damage: Leads ..... Bushings ..... Coils .....

TYPE OF CUTOUT PROTECTING: Plug ..... Expulsion ..... Drop Out ..... Other .....

Make ..... Size Link ..... Did It Blow .....

If Changed: Type Installed ..... Size Link Installed .....

LIGHTNING ARRESTERS: Make ..... Type ..... Cat. No. .....

Voltage Rating ..... On Kich Arm ..... On Line Arm ..... Ahead of Fuse ..... Yes / No

Were Neutral and Arrester Grounds Interconnected: Solid ..... With Gaps .....

Are Neutral and Arrester Grounds Now Interconnected: Solid ..... With Gaps .....

Did Arrester Fail ..... Did It Clear from Line .....

If Changed: Make installed ..... Type ..... Cat. No. .....

Voltage Rating ..... On Kich Arm ..... On Line Arm ..... Ahead of Fuse ..... Yes / No

Ground Condition: Moist ..... Dry ..... Kind of Soil .....

If Tested, What Were Results? .....

Date of Failure ..... Date of Report .....

Date of Change ..... Reported By .....

Serial numbers may be put on book.

Fig. 1—Record of changes provides data on equipment failures

Transformer Manufacturer	All Voltages 1931	All Voltages 1932	All Voltages 1933	2300 Volt 1932	2300 Volt 1933	6900 Volt 1932	6900 Volt 1933	11,000 Volt 1932	11,000 Volt 1933
"B"	82	133	91	96	55	20	10	17	26
"A"	44	89	58	73	44	6	4	10	10
"D"	12	26	20	19	13	3	2	4	5
"H"	1	7	2	1	0	6	2	0	0
"G"	13	27	17	20	15	5	2	2	0
"F"	6	7	6	2	5	1	0	4	0
OTHER	20	30	10	21	10	2	0	7	0
TOTAL	178	319	204	232	143	43	20	44	41

(a)

Protected by	1932 6.9 KV.	1932 11 KV.	1932 Total	1932 %	1933 6.9 KV.	1933 11 KV.	1933 Total	1933 %
"A" Arresters	15	17	32	5.3	8	8	16	3.45
"B" "	14	25	39	5.9	10	27	37	5.2
"C" "	1	0	1	0.5	1	3	4	1.15
Without "	13	2	15	25.	1	3	4	6.6
TOTAL	43	44	87	6.0	20	41	61	4.2

% is Transformer Failures in % of Transformers Protected by that Arrester.

(b)

Figs. 3a and b—Classification of transformer failures from lightning by make, voltage and protection permits analyses

Fig. 4—How distribution troubles are classified and consolidated for comparison

Division ALL DIVISIONS

Location

DISTRIBUTION TROUBLE REPORT

MONTH OF YEAR 193 3

Division	PRIMARY: Down Wire: Tree Trouble	PRIMARY: Down Wire: Pole, X-Arm, Pin Broken	PRIMARY: Down Wire: Miscellaneous Reasons	PRIMARY: Down Wire: Miscellaneous Tree Trouble	PRIMARY: Down Wire: Miscellaneous	SECONDARY: Wire Down: Tree Trouble	SECONDARY: Wire Down: Pole, X-Arm, Pin Broken	SECONDARY: Wire Down: Miscellaneous Reasons	SECONDARY: Wire Down: Miscellaneous Tree Trouble	SECONDARY: Cut-In Down	SECONDARY: Cut-In Removed	SECONDARY: Miscellaneous	STREET LIGHTING CIRCUITS: Wire Down: Tree Trouble	STREET LIGHTING CIRCUITS: Wire Down: Pole, X-Arm, Pin Broken	STREET LIGHTING CIRCUITS: Wire Down: Miscellaneous Reasons	STREET LIGHTING CIRCUITS: Miscellaneous Tree Trouble	St. Light Wire On Primary	Series Transformers Failure	Relay Failure Series Circuits	Relay Failure Multiple Circuits	Light Out	Picture Renewed Or Repaired	TRANSFORMERS: Miscellaneous	TRANSFORMERS: Transformer Failure	TRANSFORMERS: Primary Fuse Blown	TRANSFORMERS: Primary Cutout Failure	TRANSFORMERS: Lightning Arr. Failure	MISCELLANEOUS: Miscellaneous	MISCELLANEOUS: Pole Down	MISCELLANEOUS: Pin Broken	MISCELLANEOUS: Cross-Arm Broken	MISCELLANEOUS: Trouble with Foreign Lines	MISCELLANEOUS: Miscellaneous	Pri. on Sec.
	118	48	43		1	284				260		22	7			12	35	19441	444	819		89	61	107	430								
	1	233	18	19	1128	267	-		69	112	111	518	120		84	64	84	100	20													
	27	12	44	-	2	12	10	16	4	7	3117	16	310		34	5	1	417															
	1	11	11	3	99	8	-	3	-	2	12	36	10		10	1	2															
TOTAL	883	210	306	77	621	838	214	157	138	97	44750	560	4092		287	311	163	962														
	120	546	502	191	2267	561	56	204	137	161	873	370	341		134	175	167	21														

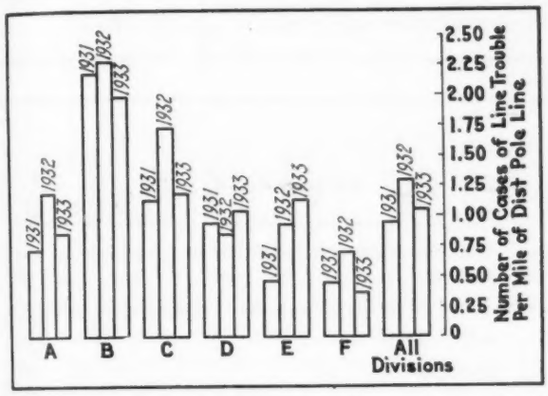


Fig. 5—Cases of division line trouble per mile for three years affords comparisons

Amount of trouble in 1932 large because of sleet storm. Majority of sleet trouble in division F was not recorded and therefore omitted.

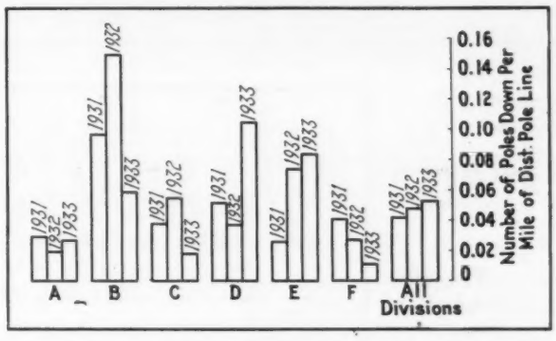


Fig. 6—Number of poles down per mile compared by divisions over three years

See subcaption under Fig. 5.

Line troubles are reported so that each local office can keep a running record through the month of all its troubles. At the end of the month the local classified totals are forwarded to the corresponding district office for consolidation and comparison. Each district, in turn, forwards its consolidated report to its division office for similar comparison and consolidation. With the division reports consolidated (Fig. 4) the general office can compare division performance and previous years.

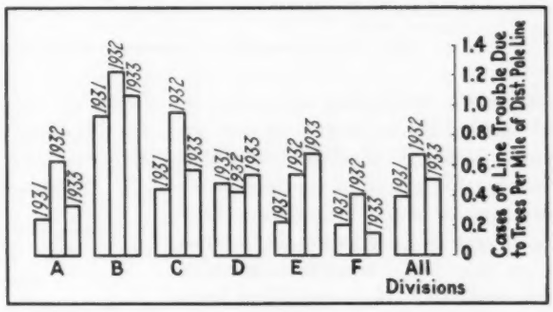
In filling out the reports, each case of trouble occurring on any one circuit from any one cause is recorded as one trouble. For instance, a tree bringing down two phases of primary is counted as one case of trouble, but if it also brings down a street-lighting conductor it is also listed as a case of trouble on street-lighting circuits. If it also brings down a secondary it is counted there too. Thus, one tree in falling may cause three cases of trouble.

At the end of every six months a summary is made and analyzed. Methods of breaking down the data to show the comparative standing of the different divisions and districts are illustrated by Figs. 5, 6 and 7. By going back to the monthly reports by districts it is possible to determine which town is throwing the district or division out of line.

To bring out the salient points of the report a summary (Fig. 8) is made breaking down the troubles in terms of equipment in service. The report includes only such items as may be obtained without a great deal of extra trouble and covers as many items as appear worth while.

Fig. 7—Number of line troubles per mile due to trees by divisions for three years

See subcaption under Fig. 5



Item	All Divisions 1931	1932	1933
Transformer failures (all causes)	515	465	548
Transformer failures % of total number	2.8	2.5	1.9
Fuses blown	3,520	4,266	4,092
Fuses blown per transformer	0.190	0.230	0.220
Fuses blown per transformer failure	6.85	9.16	11.75
Cases of line trouble per pole line mile	0.95	1.28	1.06
Cases of line trouble due to trees per pole line mile	0.39	0.68	0.507
Wires down due to trees per pole line mile	0.241	0.422	0.275
Service drops per meter	0.014	0.020	0.015
Street lamps replaced per lamp	2.05	1.95	1.90
Fixtures repaired or replaced per lamp	0.039	0.032	0.036
Relay failures	369	379	258
Relay failure per lamp	0.015	0.015	0.011
Cutout failure per transformer	0.019	0.028	0.018
Fuses blown per cutout failure	10.03	8.2	12.0
Arrester failures	180	279	267
Arrester failure per transformer	0.010	0.015	0.014
STATISTICAL DATA			
Area in square miles	52,347	52,347	52,347
Number of active meters	151,023	148,384	148,089
Miles of distribution lines	5,664	5,664	5,858
Lamps	24,416	24,416	25,542
Transformers	18,507	18,507	18,628

Fig. 8—Salient facts derived from trouble reports

TOWN Augusta, Georgia DIVISION Augusta DATE July 2-16, 193 4

LOCATION NUMBER	LOCATION	COMPANY NUMBER	SERIAL NUMBER	SIZE	TERRITORY	CUSTOMERS: Lights	CUSTOMERS: Lights & Power	CUSTOMERS: Other	AMPERES: Right	AMPERES: Left	VOLTS	K.V.A. LOAD	REMARKS
1016	404 Crawford Avenue	G.E. 304	1986569	15	B	73	6		6		2300	13.80	
1020	514 Crawford Avenue	G.E. 130	870938	15	B	52	7		4½		2300	10.35	
1022	636 Crawford Avenue	G.E. 106	1143672	15	B	88	3	2	8½		2300	19.55	
1026	806 Crawford Avenue	Wh. 415	1876316	15	B	31	5	2	4½		2300	10.35	
1430	1236 Steed Street	Ft. Wayne 35	80139	4	C	20		1	1		2300	2.30	
1330	12th Ave. & Grand Boulevard	G.E. 1199	3856203	5	C	3	2		3		2300	6.90	
1336	1943 - 15th Street	G.E. 428	3590664	5	B	15		1	1½		2300	3.45	
1012	1760 - 15th Street	Packard 1683	70456	5	C	13		1	3		2300	6.90	

Notes: (1) Territory indicated by the following: A—High Grade Residential, B—Medium Grade, C—Low Class, I—Industrial, S—Store.

(2) If current is measured with split coil, show readings in both outside legs.

Transformer-load tests are made regularly by placing thermal ammeters in the leads of each distribution transformer, and leaving connected for a week. During that time they should record a peak load. Data giving the number of customers on each transformer and class of territory are given in a form (Fig. 9) from which valuable information for planning is obtained. A summary of the tests for 1933 is shown in Fig. 10.

Fig. 9—Field tests show magnitude and class of peak load on each transformer

Demand = demand per equivalent customer. Equivalent customer is figured as follows: 1 lighting customer = 1 equivalent customer; 1 range customer = 10 equivalent customers. No additional allowance is made for commercial customers, hence the large demand on the larger transformers.

	3		5		7.5		10		15		25		37½		50		Total	
Division	% Loaded	Dem.	% Loaded	Dem.	% Loaded	Dem.	% Loaded	Dem.	% Loaded	Dem.	% Loaded	Dem.	% Loaded	Dem.	% Loaded	Dem.	% Loaded	Dem.
A	76.7	153	79.4	179	79.8	157	75.44	154	78.5	221	44.45	163	70.4	470	48.4	2420	72.7	173
B	133.		89.5		86.		74.5		65.		51.4		54.8		81.5		67.5	
C			88.6	151	100.	238	102.5	231	86.5	193	86.25	211					94.	215
D			127.5	239	128.	278	100.	221	83.6	198	73.6	204			23.	1150	101.	225
E	56.6	146	106.	196	94.	218	97.4	202	95.5	262	92.4	546	71.2	982			96.4	225
F	21.8	245	63.25	156	74.	191	76.5	137	80.	163	75.	207	72.8	323	118.	920	76.2	191
Total Company	126.	161	93.4	199	91.5	217	87.8	196	77.4	217	69.4	295	60.	508	70.7	1390	88.7	208

Fig. 10—summary of transformer peak loads

Percentage of loading and unit-customer demand for different-size transformers, by district, made with thermal ammeters in 1933.

simply a case of having this information recorded for further study and not let it die in the mind of the man doing the work. Each man in his daily work comes across some experience that, while it may be only in the day's work to him, may be of considerable value to the designer. If a simplified form of report could be devised so that this information could be turned in with very little trouble a wealth of valuable data could be had.

The following sources may be utilized for such information: (1) Line-trouble reports; (2) equipment-failure reports; (3) transformer-load tests; (4) voltage surveys.

Examples of how these data can be assembled for ready use are illustrated and some applications explained in the group comments.

Voltage surveys are made by troublemen after restoring service following trouble calls. Incidentally, this leaves a good feeling in the customer's mind. Because of the time of making these surveys, it might be said that they represent the worst conditions.

By noting the voltage rating of the lamps used by the customer at the time of the voltage reading a check on lamp sales is obtained. If the customer is using 120-volt lamps where he should be using 115-volt units the sales will be fewer than if he were using the proper rating. A summary of the voltage readings during the winter of 1932-33 is shown in Fig. 11a.

City	Low	High	No. Socket Voltage Readings	Average Voltage Socket	Average Voltage Lamp
B	100	122	3210	115.69	115.97
D	100	126	353	113.42	114.75
E	100	123	287	115.58	117.32
F	112	124	193	118.27	116.71
C	95	122	177	116.05	117.05
G	103	122	108	116.54	116.39
H	117	124	74	122.76	116.82
I	115	124	72	118.99	118.89
J	106	121	66	116.45	114.77
A	106	124	66	115.70	115.45
K	102	127	66	115.73	116.11
L	111	123	51	119.20	115.29
M	109	119	50	115.06	115.10
N	112	122	49	117.53	115.20
O	113	122	44	117.16	116.02

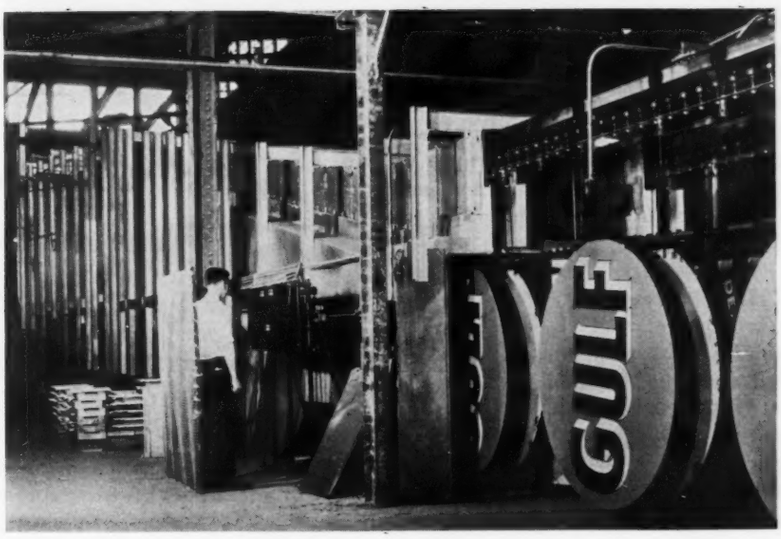
(a)

Town	Lamps No.	Lamps Size	Lamps Volts	Average Socket Voltage	% Socket Volts Below Lamp Volts	% Rated Life	% of Normal Renewals
A	120	50	120	115.7	3.58	162	61.7
C	120	60	125	116.05	7.16	216	46.3
	60	100	125	116.05	7.16	216	46.3
I	48	150	125	118.99	4.81	178	51.2
	24	300	125	118.99	4.81	178	51.2
F	24	150	125	118.00	5.6	190	52.6
E	120	100	120	115.58	3.68	160	62.5
	144	200	120	115.58	3.68	160	62.5
B	120	100	120	113.15	5.71	194	51.5
F	120	40	120	118.27	1.42	130	77.0
S	48	300	120	117.07	2.44	139	72.

(b)

Figs. 11a and b—Summary of voltage surveys and examples of odd-voltage lamps used

Continuous-type recuperative furnace burns enamel on signs



Porcelain-sign Manufacturer Increases Continuous Recuperative-Furnace Capacity to 1,310 Kw. After Attempting Economies With Fuel Type

Electric Enameling Extended

INSTALLATION of a second electric enameling furnace to supplement the electric furnace installed approximately five years ago was recently completed by the Ingram-Richardson Manufacturing Company of Beaver Falls, Pa., manufacturer of fine porcelain enameled signs and jobbing porcelain enamelers.

As early as 1915 this company realized that electric heat was the ideal way of burning porcelain enamel. Negotiations were accordingly initiated by it for the building of an electric furnace, but at that time materials which made an electric enameling furnace economically feasible were not available. In 1922 it built, on a more or less experimental basis, a 600-kw. furnace, in which the heat was generated by passing an electric current through a trough filled with granulated carbon. This furnace did not prove to be a commercial success.

In the early part of 1929 a contract was entered into for a 620-kw. recuperative-type furnace which was to have a gross capacity of 12,200 lb. of material per hour, or a net capacity of 6,400 lb. of ware for the same period. The furnace was completed in September of that year and has been in almost continuous operation since that time. It is of the elevated hairpin type, being some 92 ft. long, with a 70 ft. preheating and cooling chamber and a 22 ft. heating chamber. It is designed to burn the first or ground coat at 1,650 deg. F. and the remaining coats at around 1,550 deg.

Material going through the furnace is hung by hand on an overhead conveyor which carries the ware in a vertical position directly through the furnace. The maximum size of ware that can be accommodated is a 6x4-ft. sheet. As shown, the ware is loaded and discharged from the same end of the furnace. The cold incoming ware, therefore, passes the hot outgoing ware and absorbs a large amount of heat from the burned ware. This recuperative feature is so effective that if it were not incorporated in the furnace approximately 930 kw. would be required merely to raise the temperature of the 12,200 lb. of steel which passed through the furnace every hour.

This experience of a manufacturing concern which substituted electric-enameling for fuel-fired furnaces in 1929 and then added another electric furnace in 1934 is particularly interesting for several reasons. First, it commenced experimenting with electric heat back in 1915. Second, and more important, it thought that lower costs might be obtained with continuous-type fuel-fired ovens, and investigations were made. What led to the decision for an additional electric furnace is discussed in this article.

Early in 1933, due to increased business and to moving the operations of the company's eastern plant to Beaver Falls, the electric furnace had more work than it could possibly do. Consequently, some of the enameling had to be done in the remaining batch-type, fuel-fired furnace. The costs of burning enamel in these furnaces were entirely out of line with the continuous electric furnace. As the business continued to increase, it became apparent that a second continuous furnace should be installed.

The depression has made almost every one sharpen his pencil a bit on production costs and the Ingram-Richardson Manufacturing Company was no exception. Consequently, the latest types of fuel furnaces were investigated with the hope that the same results that it was obtaining in the electric furnace could be secured at a lower cost in a continuous-type, fuel-fired furnace. As the first cost of the comparable fuel-fired and electric furnaces was about the same, it was apparent that it was a matter of operating costs and quality of products on which the final decision would be made.

While the energy cost of the electric furnace was somewhat higher than the fuel-fired furnace, the avail-

ability and the inconsequential maintenance cost, which had been so thoroughly demonstrated by the existing electric furnace, evened up the operating cost. The quality of work produced by the electric furnace was such that the company did not feel it could hope to better it in either type of furnace.

Consequently, in September of 1933 a contract was let for a new electric furnace of a type and capacity similar to the one then in operation, but which would accommodate a sheet as large as one 10x5 ft. and would be rated at 690 kva. This furnace was put in operation about March 19, 1934. Due to the much larger size of sheets which the furnace was to accommodate, it was necessary to widen out the hairpin turn at the rear, but outside of this one major change the new furnace is identical with the one installed five years ago.

How it aided production

Continuous furnaces have done much to change the enameling process in this plant from a batch to a continuous process. Now the ground or first coat is applied in spraying booths located adjacent to the overhead conveyor of a fuel-fired drier. After the ware is dried it is taken by the drier conveyor to a point where it is transferred directly to the furnace conveyor.

After the ground coat has been burned the ware is taken to spraying booths for the second coat, then to the drier, and from there to the stencil room, where the design is formed by placing a stencil on the sign and removing by suction brushes all dried enamel not covered by the stencil. The ware is again put through the electric furnace and this procedure is repeated as much as five or six times, depending on the number of colors in the sign. Only one color can be burned at a time.

Prior to the installation of any electric furnace, this customer used approximately 75,000 kw.-hr. per month with a maximum demand of between 350 and 400 kva. After the first furnace was installed the average monthly consumption rose to around 290,000 kw.-hr. and the demand to around 860 kva.

It is estimated that with both of the furnaces in production approximately 530,000 kw.-hr. will be consumed per month with a billing demand of 1,600 kva.

Motor Drives

Small Electric Motors Provide the Flexibility Required by a Multiplicity of Operations in Garment Manufacture

GARMENT manufacturing affords a large field for the application of small electric motors. While the number of distinctly different operations is not large, many small machines must be employed on similar jobs. Stitching constitutes one of the principal operations. From cutting out the cloth up to pressing the finished garments there are many kinds of sewing to be done, involving subdivisions of the work, and each requiring a corresponding number of machine groups, dependent upon the nature and quality of the product of a particular factory. Small motors predominate.

An excellent example of the use of small motors in a garment plant is the installation in the factory of Sweet, Orr & Company at Newburgh, N. Y., one of several operated by this concern. About five hundred persons are employed turning out, in addition to overalls, for which the firm has been long and widely known, pants, shirts, riding breeches and Boy Scout clothing, as well as the distinctive uniforms worn by employees at gas stations of some of the large oil companies.

Power for the factory is obtained from the lines of the Central Hudson Gas & Electric Corporation at 2,300 volts, single phase, and is stepped down to 230 volts at the factory transformer. Some of the motors operate at 220 volts, but a larger number, chiefly fractional-horsepower units, at 110 volts.

Finds wide variety of applications

In the receiving end of the plant, where cloth arrives from the mills, it is treated to remove the nap by a machine driven by a 20-hp., 220-volt motor. To get rid of the fine, dust-like material a ventilating fan, driven by a 15-hp., 220-volt motor, is employed. Each of the two freight elevators is equipped with a 6½-hp., 220-volt motor. Protection against fire is afforded by the 75-hp., 220-volt motor driving fire pumps.

Cutting-out operations are among the first processes in garment making. For cutting to pattern, two types of cutting machines are employed—one with a straight knife, the other with a circular blade. On the first type the motor operates a vertical knife through a crank and short connecting rod and is rated at ⅛ hp., 110 volts, 3,600 r.p.m.

The cutting machine, mounted on a flat base, is equipped with a handle by which the operator can follow the pattern marked on a pile of many thicknesses of cloth, starting and stopping his machine with a push button. Where the pattern has many curves a circular-knife machine is used, the speed of this kind of cutter being reduced by means of gears. Otherwise, the machine is similar to the straight cutter.

For punching holes in a pile of material a punching or "notching"

Motors Installed in Sweet, Orr & Co's Plant

Department	Number of Motors	Operating Voltage	Revolutions per Minute	How Started	Aggregate Horsepower
Napping....	2	220	1,800	Motor starter	35
Cutting and notching...	23	110	3,600	Push button	3
Crimping....	2	110	1,800	Treadle	½
Sewing.....	42	37–110 5–220	1,800	Push button and motor starter	16½
Pressing. ...	1	220	1,800	Motor starter	3
Elevators....	2	220	1,800		13
Fire pumps..	1	220		Motor starter	75
Ventilating fans.....	2	110	1,800	Knife switch	½
Total.....	75	3	2	3	146½

in Garment Factory

By **REGINALD GORDON***
Newburgh, N. Y.

machine is used, driven by a $\frac{1}{8}$-hp., 3,600-r.p.m. motor; its hollow drill facilitates the escape of the punched-out material.

Crimping machines, for turning over the hems of garments, save an immense amount of hand labor and do the work quickly and uniformly. They are belt-driven by 110-volt, 1,800-r.p.m. motors.

However, as mentioned before, sewing constitutes by far the major process. Several different kinds of machines are used; some on light work and some on heavy, for plain sewing, double stitching, sewing curved pieces, such as pockets and pocket-flaps, button holes, etc. Most of these are mounted in groups of ten to sixteen on long tables and are belt-driven from a horizontal shaft underneath. Each machine is controlled by its operator. The driving shaft is operated through a flexible coupling by a 3-hp., 220-volt, repulsion-induction type motor with starting equipment.

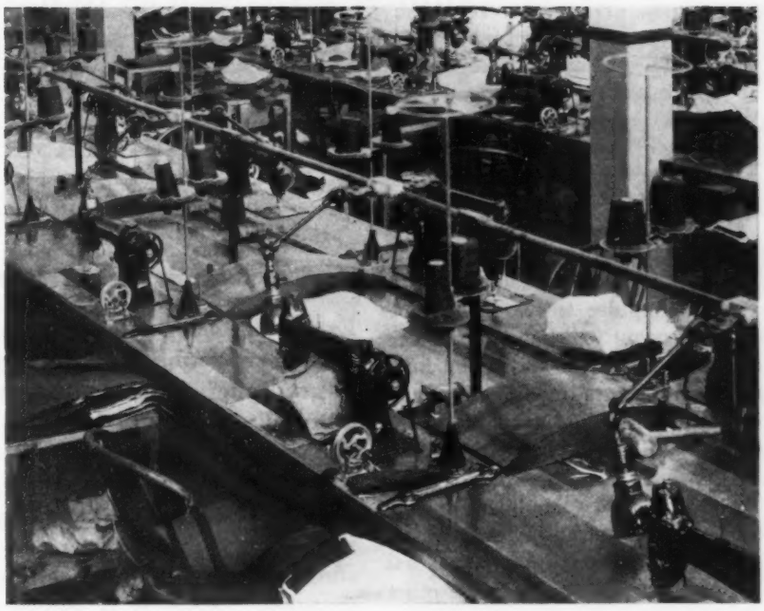
Brings speed and uniformity to mass production

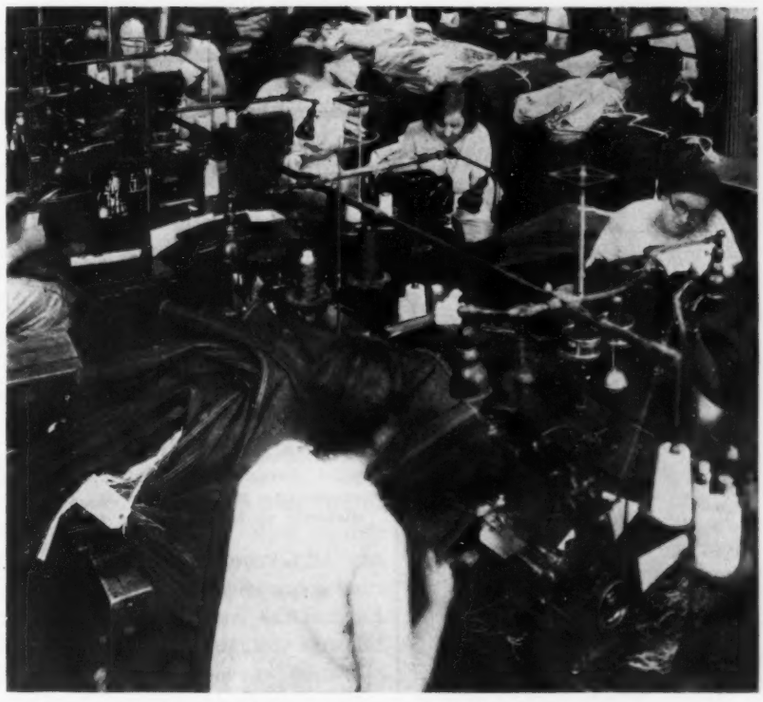
For certain special operations individual sewing machines, separately placed, are required. They are operated by individual motors and can, if necessary, be moved about. One of these machines is of a distinctive type, called a motor transmitter. Sewing table, machine and motor form one compact unit. The motor is under the table, built in, and the whole thing can be moved to any part of a factory and plugged in at the nearest receptacle. The motor drives through an automobile-type clutch controlled by a foot pedal. It is believed likely that a number of these will be installed shortly in place of older types.

For making button holes motor-driven machines cut out and stitch the holes in one operation, requiring only a motor drive similar to other sewing machines.

The finished garments are pressed on foot-operated, steam-heated machines commonly used in tailoring shops, but to dispose of the excess steam and avoid getting the clothing too damp a set of centrifugal vacuum pumps, belt-driven by a 3-hp., 220-volt motor, serves twenty presses.

In two of the more congested workrooms ventilating fans, driven by $\frac{1}{4}$-hp. motors, are used. Elsewhere a large number of desks and other small-size fans are used, dependent upon the weather.





Sections of light and heavy stitching departments
Note concentrated light on work. Machines are belt-driven by shaft under table.

*Formerly associate editor *Industrial Management, Industry Illustrated*, etc.

Sphere-Gap Standard

Usefulness Extended as Reference Standard for High-Voltage Measurement

By P. L. BELLASCHI
Engineer
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Extrapolating the calibration of the 25-cm. sphere spark gap to larger spheres has led to error, especially when applying these empirical extensions indiscriminately to both power frequency and impulse voltages. There is a movement to revise the A.I.E.E. standards for high-voltage measurement. Here it is shown that relatively short gaps are one important desideratum.

FROM the refined methods of voltage measurement now in use it is definitely known that the sphere spark gap is affected by a polarity effect. In addition its impulse ratio is greater than unity for very short impulse waves. It is evident that account will have to be taken of these considerations and recent findings in any future modification and extension of the present sphere spark gap standards (A.I.E.E. Standards No 4).

In testing either at 60-cycle frequency or with impulses, the voltage is generally applied to one terminal of the apparatus under test, the other terminal being grounded. Grounding one sphere results, however, in a dissymmetry of the voltage gradients at the sparking points on the spheres. Considering the mechanism of sparkover, this dissymmetry accounts for the difference in voltage flashover with positive and negative impulse voltages when only waves of about two microseconds and longer are considered. Positive and negative calibrations are identical up to gap openings approximately one-fourth the sphere diameter (Fig. 1).

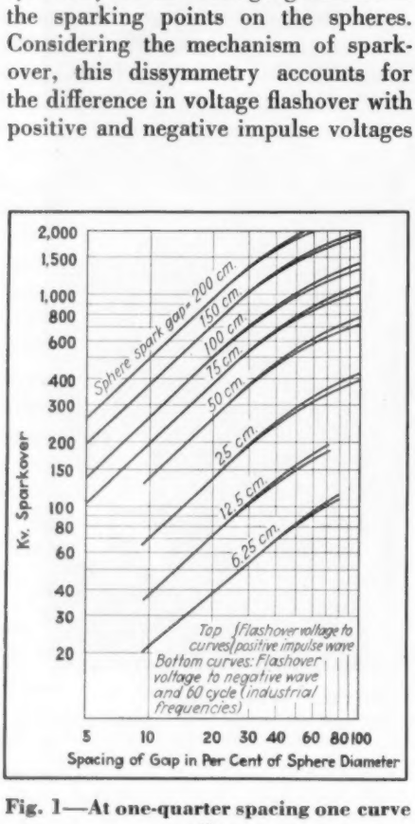

Fig. 1—At one-quarter spacing one curve suffices

Calibrations on positive and negative impulse are 60-cycle voltage identical up to one-quarter spacing in terms of sphere-diameter. One sphere grounded. Relative air density = 1.

For wider openings the positive calibration rises above the negative uniformly, exceeding it as much as 7 per cent for the 25-cm. sphere spark gap and proportionally less for the larger sphere spark gaps. The 6.25-cm. and 12.5-cm. sphere spark gaps exhibit markedly erratic performance on approaching the full diameter spacing, this effect being due to a transition in the impulse characteristics from a sphere spark gap proper to a rod gap occurring nearly at the diameter spacing for these small gaps.

At 60-cycle power frequency voltages sparkover takes place at a polarity of the wave corresponding to the lowest voltage of the two impulse calibration curves in Fig. 1. That is, *the 60-cycle calibration is practically identical to the negative impulse calibration for the permissible range of gap openings at which the sphere spark gap can be used.*

For correct measurement of the voltage over a good range of sphere gap openings one calibration is required for the positive impulses and a separate one for both the negative impulses and 60-cycle frequency combined. There would be an advantage in using sphere gap openings not greater than one-quarter or one-third diameter as only one calibration would then be required; however, the range of voltages that could be measured by each sphere spark gap would be limited.

Lag longer for small gaps

With the normal 1½-40 microsecond wave prescribed for commercial impulse testing sparkover of the sphere spark gap may appear somewhat beyond the crest of the wave, thus indicating apparently a time lag. An increase in the applied voltage of only about 1 per cent would result invariably in flashover at the crest. Exception should be taken of the 12.5-cm., 6.25-cm. and smaller sphere spark gaps, as these exhibit marked time lags at the wide gap openings; in fact, at full diameter spacing they approach performance of the rod gap.

The 25-cm. sphere spark gap was calibrated, in addition to the positive and negative 1½-40 microsecond wave, with the 1-5 and the 20-50 microsecond positive waves. Similarly, the 150-cm. sphere spark gap was calibrated with both positive and negative 1-5.5 microsecond waves. These tests establish that the sphere spark gap records correctly the same crest voltage for the 1-5, 1½-40 *smooth exponential waves* and for the longer waves. Cathode-ray oscillograms show breakdown of the 25-cm. sphere spark

Sample Calibrations of a 25-Cm. Sphere Spark Gap at Different Humidities of the Air

(1½–40 microsecond wave of negative polarity applied)

Gap Spacing in Cm.	Sparkover Voltage in Kv. Calibration No. 1 Absolute Humidity = 4.5 to 5.0 grains per cu.ft.	(Relative Air Density = 1.00) Calibration No. 2 Absolute Humidity = 2.2 grains per cu.ft.
10	246	244
12	279	277
14	308	306
16	332	332
18	353	355
20	371	374

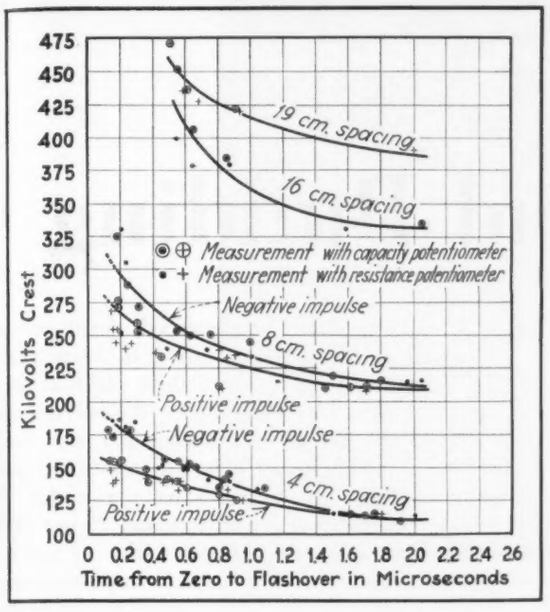

Fig. 2—Polarity effect pronounced on very short impulses

Curves for 25-cm. sphere gap. Surge generator set to produce ½-40 to 1½-40 microsecond waves of magnitudes to flashover gap on front of wave. From 0.2 to 1.0 microsecond sparkover takes place on uniformly rising part of front. The impulse ratio increases rapidly as impulse wave is shortened.

gap on the crest of these various waves. The calibration curves in Fig. 1 are applicable for all these various impulse waves.

Sparkover of the 25-cm. sphere spark gap on a very steep rising front, having a duration of a fraction of a microsecond, occurs (Fig. 2) at a substantially higher voltage than the sparkover voltage for a 2 microsecond front. The later voltage is essentially the same as the sparkover voltage on the crest of the 1-5 and 1½-40 waves. Similar data by other investigators obtained on small sphere spark gaps (5 cm. diameter and smaller) with impulse waves even shorter than those indicated reveal correspondingly higher impulse ratios. In these particular investigations on small sphere spark gaps the use of radium, ultra-violet rays and other means for preionizing the air of the spark gap has been found beneficial in reducing the impulse ratio somewhat and also in securing more consistent results in sparkover.

All these data establish that the sphere spark gap requires two calibrations to measure the crest voltage of impulses having smooth exponential waves such as the 1-5 and 1½-40 microsecond waves, which are the ones commonly used for impulse testing in surge laboratories.

Effect of air density and humidity on sparkover voltage

Calibrations of the same sphere spark gap made under what is commonly considered as widely different conditions of relative air density (0.90 to 1.10) show good agreement when the sparkover voltage is corrected in accordance with the methods prescribed in A.I.E.E. Standard No. 4. That is, within the ordinary departure from unity air density (temperature = 25 deg. C. and barometric pressure = 760 mm.) the correlation factor applied to the sparkover voltages given by the calibration curves of Fig. 1 is for practical purposes proportional to the relative air density.

Calibrations of the same sphere spark gap also indicate that the humidity of the air has no appreciable effect on the voltage sparkover. A sample example of data of this kind for impulse voltages is given in the accompanying table.

Air corrections adequate

Briefly, the present methods of correcting for relative air density (A.I.E.E. Standards No. 4) appear adequately correct, considering that inherent errors and variations in the sphere spark gap proper may amount to 2 and even 3 per cent. In addition, other errors may be encountered such as those due to the effect of ground, adjacent bodies, etc.

In high-voltage laboratories and on test floors where the larger sphere spark gaps are used (up to 200 cm. diameter at the present), space is more restricted than is generally recognized. The desired clearances to ground, from adjacent bodies and to walls, cannot always be attained readily. Hence discrepancies in measurement due to extraneous effects frequently result.

For example, tests indicate a decrease of about 2 to 3 per cent in sparkover voltage for full diameter gap opening when the grounded sphere is spaced two diameters from ground instead of five, as present standards require. At full diameter spacing adjacent walls and conducting bodies within two to three diameters produce still greater variations in the flashover voltage. Limiting the use of the sphere spark gap to one-half diameter opening practically eliminates all errors in measurement that would otherwise result from these extraneous and similar effects.

Peculiarly low flashover voltages have been observed by various experimenters on the first flashover of a sphere spark gap after a long period of rest. With ordinary cleaning of the gap before use and after some preliminary sparkovers, test experience indicates that for a given sphere spark gap and for openings not exceeding one-half diameter successive measurements of the voltage seldom vary from each other more than 2 per cent.

2,000-WATT SPOT LAMPS

Bi-plane filament, bi-post base, tubular-bulb lamps which burn base-up in front of elliptical reflectors are used in the new Metropolitan Opera House spot lamps for floodlighting from the side "flies" of the stage. They develop 126,000 cp., with 2,000 watts, and were furnished by Klieg Brothers, New York.

One of a Series of Intimate Talks With Industry Executives

Kennedy on Load Building

An Interview by
LEONARD CHURCH

THE engineers in his organization say that he is a commercial man; the commercial men insist that he is an engineer, but both parties are in unanimous agreement on one thing—that Vice-President and General Manager T. O. Kennedy has brought a superlatively high degree of co-ordination to the nine properties which go to make up the Ohio Public Service Company and to supply more than half a billion kilowatt-hours of electrical energy annually to nearly eighty thousand customers scattered over 4,000 square miles of northern Ohio.

Because in his opinion the central-station man still is in the best position of all to sell the public the idea of what electricity will do to make life more worth living, the Ohio Public Service Company has insisted on conducting aggressive appliance sales and load-building programs. It is, however, scrupulously careful to give to every local dealer the same advantages in the merchandising of appliances as it uses itself. If down payments are lowered or length of time payments extended, local dealers can make the same terms, the "O.P.S." carrying the dealers' paper, if finance companies will not. In fact, "O.P.S." was the first utility—in 1928—to finance its local dealers' paper, and on terms identical with its own. Every effort is made to keep the competition, and consequently the co-operation, between utility and local dealers on a thoroughly equitable basis.

"You know," said Mr. Kennedy, "the building of customer good will requires as much conscious effort as the building of a power station. If we are to lower rates and yet prosper, we have got to sell more kilowatt-hours to spread our fixed charges over." One of the innovations which is credited with corralling many additional kilowatt-hours for the "O.P.S." has been the repairing of electrical appliances right on the customer's premises, with the only charge made that for new parts when these are required. One full-time electrical repair man is maintained in each of the communities served. This activity, because it is confined to a service admittedly unprofitable for the individual electrical dealer to handle, has further enhanced co-operation and good will. In the two years the program has been in effect it has brought excellent results in restoring to active service those current-consuming home appliances which, because out of repair, were out of use.

Commenting on the assumption of many utility executives that their most important job is the maintenance of good public relations, Mr. Kennedy maintains that the surest way to accomplish this is through commercial activity and the sale of more and more service to a public thus made conscious of what electricity can mean to it in improved living conditions.

"We know," said Mr. Kennedy, "it is the customer with the small bill who kicks. He complains not so much because he thinks the rate is too high as because he feels, consciously or subconsciously, that he is not getting the full advantage of the many comforts and conveniences of electric service. To meet such situations we need a rate schedule that will encourage a customer to use more service, plus a selling schedule which will persuade him that he *can* use additional service. Having already invested frequently as much as $500 in permanent facilities to serve such a customer, it seems to me that we might go further, if necessary, and finance his purchase of the principal current-consuming devices—even if the account has to be carried for as long as five years. The original investment we've made is for all time and cannot be recovered even if it proves to be unproductive."

Due, in Mr. Kennedy's opinion, as much to the lack of any sustained drive for new business as to Old Man Depression, commercial development in utilities has failed to keep pace with the growth of their physical systems. Whereas during the last decade the average investment per customer in the industry has increased 38 per cent, the energy sales per dollar of investment have decreased 20 per cent and the revenue per dollar of investment 26 per cent. Improvements, however excellent, made in operating efficiency are not of themselves sufficient under such circumstances to prevent a decrease in net return.

The first step in solving the problem of increased sales, according to Mr. Kennedy, is to establish promotional rates with a minimum payment to cover a reasonable number of kilowatt-hours—10 kw.-hr. per month, for example, to meet the needs of the purely convenience users—the rate for additional current to reduce rapidly to 3 cents per kilowatt-hour—to 2 cents per kilowatt-hour for larger amounts. Such a rate form would not only be of maximum benefit to the customer but also to the appliance manufacturer and to the dealer, as well as to the utility industry.

With rates of this type in effect, Mr. Kennedy believes utilites can promote successfully complete home electrification, co-operating actively with all retailers of electrical equipment in putting appliances on power lines as rapidly as possible. Nor, insisted Mr. Kennedy, must we overlook the opportunities to increase sales to commercial and industrial establishments which are quick to take advantage of the use of electricity as a means of improving their operations. Properly to enlarge this market, he believes it is only necessary that power rates at all times be kept competitive with other forms of power and for the utility to co-operate with industry in the development of new applications of electricity. All of which may help to explain why "Ted" Kennedy today is able to point in the territory of the "O.P.S." to an average annual revenue per domestic customer of $38.47.

T. O. KENNEDY, vice-president and general manager of the Ohio Public Service Company—an experienced executive who illustrates the possibilities for building revenue and good public relations through intelligent selling. Full co-operation with dealers is a basic principle applied. Promotional rates are necessary to get more business, but they must be supplemented by planned promotional efforts.

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L. W. W. MORROW · EDITOR

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Clarify Farm Line Policies

THE potential availability of so vast a sum as $100,000,000 for rural electrification in the hands of the Administration brings into sharpest focus the problem of establishing utility policy with respect to this development. That the farmers still outside the economic reach of power systems want service can be taken for granted. Likewise, the operating companies of the country are anxious to add rural load to their present business, provided it can be acquired with fair prospects of ultimate profit.

In its essence the problem boils down to the best way to bridge the gap between the existing lines and the farm. This involves determining the reasonable limits of line construction if subsidized by government funds or credit; finding out the extent to which present companies can allow themselves to discount the future in pushing lines into the hinterland at their own expense or by recourse to federal loans; determining what may be feasible in the way of financing equipment and appliances to increase the use of electricity on farms already reached and within striking distance of present systems; considering who shall build, operate and maintain these rural lines, and working out plans for closer relations with farming interests and the governmental personnel (farm bureaus, county agents, etc.), which are doing such valuable work for the agriculturalists in so many channels of understanding service.

If government money is to be used to carry lines into lean territory, as now seems probable, the essential question would seem to be how to establish the simplest and fairest relationship between all parties concerned. The existing power companies are the logical source of supply of energy except where costs are so far out of line that a regional plant is the engineering (not the political) answer. Service can be carried to remote farms by a number of schemes of financing and credit. In the long run the farmer will be best served by the scheme with the lowest over-all cost. So far as possible it should work out that the power company will supply the energy to these farms as it does to its other customers and on rate schedules of the promotional type. The farm is an excellent load prospect if its owner or operator can afford to use refrigeration, electric cooking and miscellaneous power and heating applications. The average annual energy consumption on 7,131 Massachusetts farms is 1,303 kw.-hr. per year, and on dairy farms 1,726 kw.-hr., according to a recent survey. In this connection the use of federal funds to finance electrical equipment on farms already served by central stations would not only bring down the average rate paid by such customers, but it would extend the economic length of rural lines into the so-called "next best" country areas.

There is little doubt that the impetus given to rural electrification by the work relief act and the growing demand for service to farmers will stimulate liberality as to many extensions by power companies. On some fair basis of amortization lines financed with government funds should logically revert to the power systems after usage has liquidated their cost.

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Ontario Welches on Contracts to Avert Rate Rise

ONTARIO HYDRO is giving a fine example of what government does when it gets power over power. When things were booming the old commission contracted with four private hydro enterprises in Quebec (Gatineau, Beauharnois, Ottawa Valley and McLaren Quebec) for energy to meet the expected shortage in Ontario. Now, with loads slumped, the province abrogates these contracts so as to avert an inevitable boost in local rates. The current deficits are erasing the book surplus at an alarming rate. The province takes the easy way out; it throws the burden on the British and American bondholders of the Quebec companies. True to form, the scepter turns into a specter for those who have a dollar to invest for public service.

The technicality on which the action is based is that only the Dominion government could have sanctioned the transaction by which Ontario province went across its boundaries to obtain a supply from private corporations which likewise were not privileged to trade outside the Quebec area. One contemplated adjustment is to let the Quebec companies sell their output in the United States, thus tolerating a sin in expiation of a simpler misdemeanor. Meanwhile, the credit of all Canada is rudely shaken by this repudiation. It all serves as a good example of what political administration can do when it finds its boasted "yardstick" prestige tottering.

Attorney-General Roebuck of Ontario said: "Hydro has been grossly mismanaged. Stupidity or worse has characterized the conduct of its affairs." Presumably that was directed at management policy and not at engineering.

Stations Too Can Set a Shining Example

SHOEMAKERS' children proverbially are poorly shod. Electric enterprises frequently will find themselves open to the same adverse criticism if they would examine the lighting in their stations, substations and service buildings. General and district offices nowadays reflect what the utilities would have their customers do by way of lighting up. But the buildings removed from mass public gaze have not in general been brought up to comparable levels of illumination. In fact, one operating engineer has said that not one station in fifty has adequate lighting as measured by the standards under which the lighting sales staff makes its showing.

Right back at the design stage is where the oversight leads to the undersight. Wherever this has happened let there be analysis of foot-candles, glare, contrasts and visual acuity in the operating areas. It is even conceivable that buff or some other color would be better for switchboards than the conventional black, large areas of which tend to swamp the bright areas of meters. Maintaining continuity of service is still somewhat in the province of the human element in the stations and all lighting factors should be of such quantity and quality as to avert errors and get the quick perception which industry has found pays in safety, in productive results and human effectiveness.

And after it is assured that the active operating areas are at proper levels of illumination there will be the task of checking switch galleries, pump rooms and similar unattended spaces to see that outlets and wattages are there ready for use when needed to get the light into the pockets and corners that abound. Meanwhile, the awakened realization should be influencing the designers of new stations and buildings toward the virtues of having light an initially inbuilt feature.

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Watch the Drive Against Stream Pollution

MANY communities are already relying on a pumped water supply and more are likely to do so as a new movement begins to have major effect. Connecticut, Pennsylvania and other states have set up water commissions which will reconcile the conflicting demands of their communities for watersheds, stop the pollution of streams by industry and by city sewage and work for general conservation and technical proficiency. Recently the first moves were made toward integrating these state activities and sponsoring a national program, possibly under the ægis of the National Resources Board.

Something is sure to come of this, even if it merely strengthens what the states will do for themselves. The dander of the Izaak Waltons is up, the public healthers are aroused, and even the mere forgotten citizen would enjoy it a bit if the water in his rivers looked more like *aqua pura*. It is inevitable that approaching limitations of watersheds and distances will drive cities to draw upon the rivers for pumped supply. Washington and a group of New Jersey communities are pumping river water and generating power from the present surplus water to eke out what energy they buy from the local utilities (this sounds paradoxical, but it is true). In short, this national trend is something the power industry should watch as it watches any high load factor base load shape itself. Incidentally, some of the processes by which sewage is so disposed of that it will not pollute the streams use considerable energy for pumping, centrifuging and purification.

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Distribution on a Progressive Scale

MUCH of the difficulty in keeping distribution costs down arises out of the problem created by irregular growth in load. If these growths could have been known with any degree of certainty it is probable that distribution would not have been allowed to drift so long. But the data for such prognostications were in the boundary area where engineering economics fringed off into appliance development and sales promotion. It was quite natural that distribution should have been left in a realm of expediency. It was so easy to dash out with the truck to set a few new poles, take down a transformer and put in a bigger one, enlarge wire sizes, reroute circuits, etc. It was not so easy to foresee the need for these unplanned changes or to anticipate them in the initial layout so that the evolution would take place at minimum outlay.

Now, however, the literature of load building and forecasting and the trend of city street widening, etc., has grown to the point where intelligent planning for distribution can replace mere expediency measures. Coupled with this is an accumulation of performance data on voltage drop, flicker, four-wire systems and networks. Paralleling all this, there has been standardization of ratings and development of new regulating devices and protective measures. In short, the time has arrived to apply intensely to distribution engineering the same discriminating design that has marked generation, transmission and load-center substation planning.

Some systems have already made real practical progress in applying semi-universal distribution schemes which are capable of large expansion at low cost. Engineers of those systems are working under Merrill DeMerit to collate all the principles and results of such progressive distribution design. They are sponsoring a series of articles in ELECTRICAL WORLD. The first one appears in this issue. Assurance is given here that those papers will lay the foundation for modern distribution engineering.

Court Bars Project on P.W.A. Funds

Ruling by Federal Judge enjoins South Carolina County and Ickes — Property rights basis of decision

Use of Public Works Administration funds to set up a power plant in Greenwood County, South Carolina, was barred this week in a ruling made by Judge H. H. Watkins in Federal District Court in Greenville. The court granted an injunction to the Duke Power Company against the county and Secretary Ickes as P.W.A. Administrator, prohibiting use of such funds in the Buzzards Roost electrical project on the Saluda River.

Judge Watkins held that the project in effect would be a proprietary and not a public enterprise, since its primary purpose was the development of power to be sold to private interests. He ruled that the effect of the project would be to impair and destroy the business of the Duke Power Company. The judge said that he did not challenge the abstract right of the government to build utilities or to regulate rates, but that, in this instance, he would decide according to proprietary rights.

The judge held that the Constitution's clause relating to regulation of interstate commerce did not apply, since the project could be construed only as manufacture or commerce within a state. The plan, he held, comprised only the generation and sale of power locally, not outside South Carolina. "Congress cannot legislate to provide for such a local enterprise under the 'general welfare' clause of the Constitution," he said. "It can claim no powers not specifically designated it by the Constitution." He upheld the contention of the power company's bill of complaint that the cost of the construction of the project would exceed the amount to be appropriated by approximately $1,000,000. The contract provides for a loan or grant of $2,852,000 for the construction of the project.

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R.F.C. Vote in Utility Stock Fought; Receiver Asked

Court action to restrain the Reconstruction Finance Corporation from voting controlling stock in the Utilities Power & Light Corporation, dominated by Harley L. Clarke of Chicago, has been filed at Wilmington, Del., by Norman C. Norman. A New York jeweler, Mr. Norman brought suit in Chancery Court as holder of 100 shares of 7 per cent preferred shares of the Public Utilities Securities Corporation which he alleged was insolvent and petitioned for appointment of a receiver. The R.F.C. became a party at interest in the Utilities Power & Light System six weeks ago, when it elected five of the eight directors to the board of the Public Utilities Securities Corporation, whose principal asset consists of 500,000 class B voting shares of Utilities Power & Light (ELECTRICAL WORLD, March 30, page 125).

The chancellor issued an order restraining the directors of Public Utilities from voting the 500,000 Utilities Power & Light class B shares or from creating a new voting trust in which the shares are to be held. A hearing on the appointment of a receiver is set for May 6.

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To Vote on Duke Merger

Stockholders of the Duke Power Company and the Southern Public Utilities Company are to meet in New York April 30 to act upon the proposed merger of the two affiliated corporations (ELECTRICAL WORLD, April 13, page 50).

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Housing Program Announced by General Electric

A housing program of unprecedented sweep and ambition, designed to produce one new house for each 100,000 of population throughout the country by September 1, 1935, has been launched by the General Electric Company with the announcement of its home-building program. The general plan is to offer selected builders new ideas, prize-winning drawings, substantial discounts and terms on electrical equipment, and national advertising and support, all in consideration of the construction by these builders of demonstration style houses. The company is already assured of the co-operation of the Federal Housing Administration and of numerous builders, publishers and banks which are anxious to help, it was declared.

An outgrowth of the recent General Electric architectural competition, in which more than 9,000 architects submitted some 2,000 sets of drawings, the program will be carried out through committees formed in the various sections of the country during this month.

President Creates Rural Line Agency

Announces formation of three divisions to administer works-relief fund — Detailed program not yet drawn up — Three methods to be used

At the press conference held last Wednesday at the White House President Roosevelt announced the creation of a rural electrification division as one of the three new agencies to aid the regular government departments in the administration of the four-billion-dollar works-relief fund. The President definitely stated that the division will not be put under the Federal Power Commission since the commission is regarded as a *quasi-judicial* body. A division head will be named shortly. Grade crossing elimination division and rural resettlement division are the two other new agencies. All three divisions will be temporary, probably functioning only during the year allotted for expenditure of the fund.

Definite announcement of the plan for expending the rural line appropriation is expected shortly. In the meantime only a tentative indication can be given. Under the provisions of the works-relief act federal authorities hope to add 83,000 miles to the rural network of electric distribution and transmission lines. Of that total full data have been gathered on 30,000 miles of line which power companies regard as having the greatest immediate potentialities.

Three methods of constructing rural distribution lines will be used. They are: (1) By loans to the privately owned utility serving the region; (2) by a state agency using federal funds, and (3) by loans to district organizations of power users.

Since the trained crews of existing utilities can most readily build lines at an average cost of $1,000 a mile, it is believed that this method will be used wherever possible. Lines built by the other methods promise to be more costly —ranging up to $2,000 a mile and even more in some instances.

Retirement of government investment

All lines will be built under government supervision, just as are other public works projects for which the government has made a loan or grant. Wherever possible it is hoped that terms can be

made that will permit interests concerned to acquire the lines through gradual retirement of the federal government's investment.

A part of the program is expected to be an intensive study of how electricity can be used to increase income on the farm and in rural communities. Irrigation outside of the arid regions is being relied upon to provide a pumping load. There are few states which would not benefit greatly if provisions were made for irrigation. There are times in practically every crop season in the states east of the Mississippi when water could be pumped to advantage into a simple system of ditches. By using off-peak power this could be made a source of additional farm income on many properties and would be an insurance against crop failure. With electricity for refrigeration and for operating cream separators revenue from dairy products could be increased. Larger scale canning operations could be undertaken. Poultry raising would have more financial promise if there is power for incubators and brooders and if henneries are lighted.

Surveys already made reveal that from 20 to 50 per cent of the farms along existing lines are not using electricity. It is believed that the percentage of nonusers can be decreased if ways are found of reducing the cost of wiring and of appliances.

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Illinois Strike Ended

In compliance with a temporary injunction issued by Circuit Judge Jett at Hillsboro, Ill., the strike order affecting the southern Illinois territory of the Illinois Power & Light Corporation has been rescinded by union leaders.

Wheeler-Rayburn Bill Hearings Open Before Senate Committee

MacLane, New York attorney, backing holding companies, assails measure — Charges invasion of private property rights — R.F.C. official suports bill — Egan defends present state regulation

That holding companies could automatically remove themselves from the death sentence implied in Title I of the Wheeler-Rayburn bill has been strongly suggested by several of the proponents of the legislation to appear before the Senate committee on interstate commerce in hearings which commenced on Tuesday, April 16. The procedure outlined would be for holding companies voluntarily to divest themselves of the actual control of operating utilities and become, in effect, strictly investment trusts. The *modus operandi* for achieving this latter status might involve the enfranchisement of the classes of holding company securities at present without voting power, the exchange of some securities with other investment groups, or the actual marketing to the general public of securities which would have the effect of distributing or diffusing the much-criticised control of the operating units.

First to appear before the Senate committee was Dr. Walter M. W. Splawn, now of the I.C.C., who repeated in substance his testimony before the House interstate and foreign commerce committee of last February 19.

Col. William T. Chantland, attorney in charge of the legal division in the utilities investigation by the Federal Trade Commission, and at the time chief assistant to Judge Robert E. Healy, told the committee the details of the character of the evidence which had been gathered and how it was gathered, and in general covered the ground which Judge Healy had previously covered before the House committee.

Corcoran rejects regulation

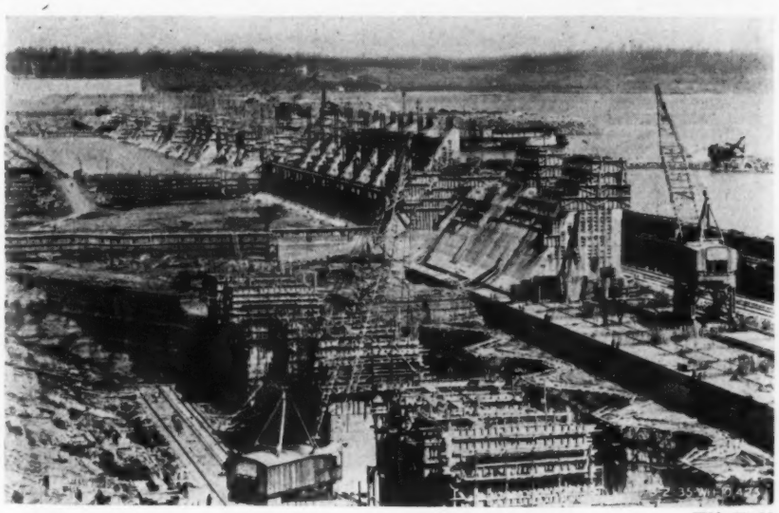
The effect of the dissolution of holding companies was described in general terms by Thomas G. Corcoran, counsel of the Reconstruction Finance Corporation. While admitting that the holding company system may have had certain benefits, he rejected regulation as a cure for practices under criticism, stating that in his opinion it would be "absolutely impossible for the government to regulate the utility holding company." Cross-examined at considerable length by several Senators, including Senator Hastings (R.) of Delaware and Senator White (R.) of Maine, as to how a program of eliminating the holding companies could be carried out without seriously impairing the whole industry and destroying completely the value of securities now in the hands of the public, Mr. Corcoran sought to show how the holding company could drop control of its properties without relinquishing ownership by giving voting rights to preferred-stock holders or bondholders of the operating companies.

The week's hearings were concluded with the appearance of Dozier A. DeVane, solicitor of the Federal Power Commission. Mr. DeVane's testimony confined itself to Title II of the bill, which deals with proposed amendments to the Federal water-power act. Challenged as to which section of the proposed legislation was the more important to pass—Title I, dealing with the elimination of the holding companies, or Title II, proposing amendments to the water-power act which would give sweeping authority to the Federal Power Commission—Mr. DeVane strenuously defended the latter, while urging that both be incorporated into law.

Lack of plan deplored

The start of the second week of the hearings provided the holding companies with their opportunity for rebuttal. First to appear before the committee was John F. MacLane, of counsel for the Committee of Public Utility Executives. Mr. MacLane is a member of the law firm of Simpson, Thacher & Bartlett of New

POWER HOUSE SECTION OF JOE WHEELER DAM



Wide World

General view of the construction work to date on the Joe Wheeler Dam 12 miles above the Wilson Dam, built by the Tennessee Valley Authority.

York, general counsel for Electric Bond & Share Company. Pointing out that the holding company is absolutely essential to supply the capital necessary for the progressive development of the electrical industry, Mr. MacLane insisted that these financial requirements are utterly beyond the investment resources of the territories served by any operating companies, except the few which are located in the large financial centers of the country.

"Much has been made," continued Mr. MacLane, "of the alleged unsound capitalization of utilities and the consequent injury resulting to investors from sales of their securities. Yet, of the 424 major companies reporting to the Edison Electric Institute, bonds in the amount of only 8/10 of 1 per cent of the total outstanding bonds of these companies are in default on interest charges, and dividend arrearages have accumulated on only about 4 per cent of the outstanding preferred stocks of these companies. All of the major holding companies now in existence have paid, and are paying, their fixed charges in full.

Pointing out that the Rayburn-Wheeler measure proposes to liquidate these companies in the midst of the greatest depression within memory, of which the end is still a matter of prophecy, and at a time when the dislocation of values of all businesses is still in effect, Mr. MacLane deplored the "utter lack of plan, or coherent proposal for a plan, for the gigantic operation contemplated." "In conclusion," said Mr. MacLane, "this bill impresses me, both in its holding company and operating company provisions, as based upon a fallacious construction of federal power, and invasion of private property rights, practically destructive of the industry which it proposes to regulate, and as substituting for existing local regulation a centralized federal supervision so all embracive as to displace effective local regulation."

T. Justin Moore of Richmond, Va., of counsel for the Committee of Public Utility Executives, said: "It is quite generally recognized that this bill in its present form is filled with constitutional questions which will not be settled for many years to come. Time does not permit a consideration of constitutional arguments. We cannot, however, pass unchallenged the assumption that the power of Congress to regulate interstate commerce and the use of the postal facilities authorizes the legislative sentence of death and confiscation of the property of the owners because of alleged misdeeds of certain owners in the past."

The statement that regulation of public utilities by the states has broken down is "rot and nonsense," according to Louis H. Egan, president of the Union Electric Light & Power Company of St. Louis. "Such a statement," Mr. Egan testified, "is inspired by those, and only by those, who want to submerge the power and authority of the states in favor of the federal government. . . ."

In the meantime the House interstate and foreign commerce committee, which has begun work to put the utility bill into final form, by an informal poll was shown to be standing 14 to 11 against abolition of utility holding companies.

•

Fought Delaware River Project at Hearing

Proposal to dam the upper Delaware River in a $29,600,000 hydro-electric development was opposed at a hearing held this week in Philadelphia by spokesmen for a group of cities and several utility corporations. The only speakers in favor of the project were Hugo A. Spalinski of Trenton, president of the newly formed Electric Power Company of New Jersey, and his counsel, Romulus Rima. The new company seeks a preliminary permit from the Federal Power Commission to survey the upper Delaware basin with a view to erecting three dams and power plants between Easton, Pa., and Port Jervis, N. Y.

Former Judge William H. Speer, counsel for the Public Service Electric & Gas Company of Newark, charged that Mr. Spalinski was a "promoter" without financial responsibility for such an undertaking. Other utility companies in Pennsylvania and New Jersey protested that already existing plants have sufficient capacity for the needs of the two states for 20 or 30 years to come. Opposition to the project was voiced by representatives of numerous cities whose power or water supply would be affected.

•

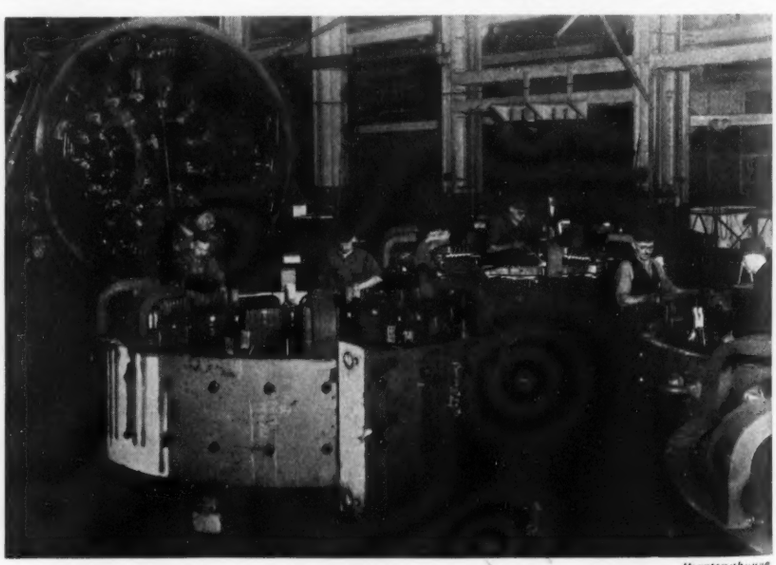
State Power Board Wins Niagara River Decision

Maintaining that state courts should not interfere with the functions of state regulatory commissions, the New York State Court of Appeals in Albany upheld this week the action of the State Water Power and Control Commission in demanding payment from the Niagara Falls Power Company for excess water diverted from the Niagara River.

The power company contended, in litigation pending since 1929, that the commission exceeded its authority in demanding from the power company $5 annually per horsepower on each 500 cu.ft. per second of water diverted from the Niagara River in excess of 15,100 cu.ft. used by the company. This amounts to $52,500 a year. In addition the commission demanded payment by the company of $425,000 for water rentals in arrears. The Appellate Division had upheld the contention of the power company, but the state carried the case to the Court of Appeals.

"The power commission," the opinion said, "has been intrusted by the Legislature to deal with these specialties, and as long as they have acted in accordance with the due administration of law by affording a hearing, taking evidence and giving their judgment or award, we cannot, nor must the Appellate Division, interfere with their conclusion . . ."

STATOR FRAMES FOR 37,500-HP. STRIP MILL DRIVE



Westinghouse

These stator frames will be part of the drive, totaling 37,500 hp., for a 79-in. strip mill of the Youngstown Sheet & Tube Company. Six of these 3,500-hp. motors will drive the finishing stands. The frames at the right are for the two 3,000-kw. motor-generator sets

T.V.A. Bill Hearings Concluded Before House Committee

Report on McSwain bill expected soon — Norris bill pending in Senate — Court sets T.V.A. appeal hearing for June 17 in Atlanta

Hearings on the McSwain bill strengthening and expanding the activities of the Tennessee Valley Authority have been completed by the House military affairs committee. David E. Lilienthal, T.V.A. director, was the last witness. Among other things the questioning brought testimony that the authority's monthly payroll is $1,000,000, that it will continue at this figure until 1938 and that land is being acquired at an average cost of $50 an acre. Mr. Lilienthal denied that T.V.A.'s primary objective is the manufacture and sale of electric power, or that T.V.A. had tried to induce industries in other regions to move to the Tennessee Valley with promises of cheap power. "We have a definite policy against the removal of an industry from one section to another," he said. "But we are conducting research work to develop small industries to augment the income of farmers."

Provisions of measure

The bill proposes to increase the amount of bonds which the T.V.A. may issue to finance its operations from $50,000,000 to $100,000,000, to conduct a soil erosion program in seven states, and to authorize the purchase by the T.V.A. of municipal power plants if the people show by referendum vote that such action is desired. In addition, the bill gives T.V.A. specific authority to generate, transmit and distribute power. This provision is intended to counteract the recent Grubb ruling (ELECTRICAL WORLD, March 2, page 47). Introduced by John J. McSwain, Democrat, South Carolina, the bill has met stupendous opposition from public utilities, coal interests and other organized groups (ELECTRICAL WORLD, April 13, page 44). A recent poll of the military affairs committee indicates that the bill faces almost certain defeat. A report on the bill is expected soon. A similar bill, introduced in the Senate by Senator Norris, has been reported to that body by the committee on agriculture and is now resting on the calendar. The measure was reported without public hearing.

The Federal Circuit Court of Appeals in New Orleans has ordered a hearing in Atlanta on June 17 on the appeal of the Tennessee Valley Authority from the district court decision handed down by Judge W. I. Grubb in Birmingham referred to above. In the opinion of James L. Fly, general solicitor for the T.V.A., this date would permit placing the case before the United States Supreme Court in October for a final ruling. The Justice Department is co-operating with the Tennessee Valley Authority in preparing its appeal. Previously, Attorney-General Cummings said that the T.V.A. would handle its own court matters. "Because this case involves the fundamentals and affects the very life of T.V.A., we now are co-operating," he said.

•

Government to Continue Insull Prosecution

Announcement has been made by the Department of Justice that the federal government has no intention of dropping prosecution of Samuel Insull, charged with violation of criminal provisions of the bankruptcy act. Attempts will also be made, according to a statement issued by department officials, to locate Martin Insull and return him to this country for further trial with his brother on the bankruptcy charges.

Testimony has been completed in the suit brought in the federal court in New York by Insull investors against five New York banks and the General Electric Company. Arguments on the evidence presented during the last seven weeks will be heard by Judge Julian W. Mack on May 13.

•

Consolidated Gas Approves Profit-Sharing Rate Plan

At a hearing held this week the Consolidated Gas Company and its subsidiaries agreed to a proposal of the New York Public Service Commission to withdraw present petitions for increased utility rates designed to meet new taxes and to submit to the commission a three-point plan for profit-sharing rates. The plan would be restricted to electric rates only and to New York City and would be experimental, subject to approval of the commission after presentation by the companies. The plan suggested by the commission and accepted by the companies includes: (1) An immediate reduction in rates to general consumers; (2) decreases in rates to the full extent of any decreases in operating taxes or governmental charges levied by local, state or federal authorities; (3) further reductions as operating expenses are decreased or profits increased.

The commission approved opinions recommending that reductions in electric rates proposed by the Westchester Lighting Company and the Yonkers Electric Light & Power Company be permitted to become effective without approval if they are filed in accordance with the law and that final determination of reasonable rates be reserved until rate proceedings now pending against both companies are completed.

Floyd L. Carlisle, chairman of the Consolidated board, acted as spokesman for the utility. He said: "The failure of the Legislature to pass the bill permitting the merger of practically all the companies in the Consolidated system has perhaps made more difficult the inauguration of a profit-sharing plan, but I don't think it is at all insuperable." The bill died in committee when the Legislature adjourned last week.

Secretary Morgenthau has announced that the Treasury Department would accept the Consolidated offer for supplying electric energy in New York in federal government buildings provided that the city obtains as good an offer from the company as the Treasury obtained.

•

Chamber of Commerce Features Natural Resources

During the annual meeting of the Chamber of Commerce of the United States in Washington, April 29 to May 2, a round-table meeting dealing with natural resources will be held. Recent developments have brought into prominence the problems peculiar to the natural resources industries as a group. C. E. Bockus, president of the Clinchfield Coal Corporation, New York, and a director of the chamber, will act as chairman. Among those making addresses at the round-table meeting scheduled for May 1 will be E. W. Allen, vice-president of the General Electric Company, who has chosen as his topic "Electric Power—The Progress Made and Coming Developments."

•

Westinghouse Reports 50 per Cent Rise in Orders

Andrew W. Robertson, chairman of the Westinghouse Electric & Manufacturing Company, made public this week a report for the first quarter of 1935 showing orders received 50 per cent higher and sales billed 46 per cent higher than in the similar period of last year. Orders received were $30,762,901, against $20,237,588 last year. They were the highest since the second quarter of 1931, excepting only the second quarter last year. Sales billed were $26,212,802, compared with $17,994,045 a year ago, and were the highest for any quarter since the third quarter of 1931.

Net income totaled $2,326,496, contrasted with a loss of $1,776,152 in the first quarter of 1934.

Edison Electric Institute to Meet in Atlantic City

In view of the expressed wishes of the members of the Edison Electric Institute, it has been decided that the third annual convention be held at Atlantic City, N. J., instead of at Washington, D. C., as had been previously announced. Arrangements are accordingly being made to hold the convention at the Hotel Traymore, during the period June 3-6.

Five general sessions loaded with subjects of vital interest to the electric light and power industry promise to make the 1935 convention the most important gathering of members of the industry in recent years. Starting on Monday morning with a session at which such matters as the rate situation nationally, the practical experience of different companies with the various types of promotional rates, just how the rates were made, subsidized electric plants and rural electrification will be discussed by authorities in these fields, the convention will continue with general sessions on Monday afternoon, Tuesday morning, Wednesday morning and Wednesday evening, carrying a program of absorbing interest.

Several nationally recognized leaders in other fields will also be invited to speak during the convention on matters of present concern to the utilities.

•

Pacific Coast Prepares for International Exhibit

The California Pacific International Exposition will open in San Diego, Calif., on May 29. Officials of the exposition have announced that impressive and instructive displays of many leading electrical manufacturing companies, as well as light, power and communication companies, will result in a showing of the electrical industry which will be the most spectacular ever witnessed on the Pacific Coast. The majority of these exhibits will be housed in the impressive Palace of Electricity, one of the many display buildings erected along the acacia-lined Avenue of Palaces, the principal thoroughfare.

•

Allis-Chalmers Statement Shows Substantial Gains

For the first quarter of 1935 the Allis-Chalmers Manufacturing Company reports a loss of $22,242, after all charges, including debenture interest and depreciation, on billings of $6,697,646. This compares with a loss in the similar quarter of 1934 of $677,153, on billings totaling $3,298,383.

Orders received for the period amounted to $6,866,080, an increase of 49 per cent over the $4,597,656 reported in the 1934 quarter. Unfilled orders March 31, 1935, aggregated $8,182,293, compared with $7,725,272 on the same date a year ago. The March 31, 1935, balance sheet discloses net current assets of $23,216,102, compared with $22,707,381.

•

General Electric Reports Five Cable Improvements

Five major improvements in the construction of G.-E. paper-insulated cable which result in cable of smaller diameter over all, higher dielectric strength, increased reliability and longer life have been announced by the General Electric Company.

The first of these improvements is a new compact-strand conductor which reduces the diameter of the cable, gives it higher dielectric strength, lowers the a.-c. resistance and results in longer life. In addition, the change from annular to segmented construction in large single-conductor cable increases the current-carrying capacity for a given diameter. Second, the layers of insulation are graduated, with superdense paper next to the conductor, improving the mechanical and dielectric strength. Third, the insulation is washed in carbon-dioxide gas, providing a more thorough impregnation and eliminating oxygen and moisture. Fourth, the lead sheath is applied by the General Electric hydrogen process, which eliminates oxidized areas and provides a sheath free from weak and inferior spots. Fifth, on all classes of G.-E. type H cable the metal shields are interlocked with paper tapes, which results in more satisfactory shielding.

•

Missouri Utility Offers to Cede White River Site

Contending that economic conditions do not warrant the construction of the hydro-electric project at this time, the Empire District Electric Company has advised the Federal Power Commission that it is willing to surrender its license to construct, maintain and operate the dam and power plant on the White River at Table Rock in Taney County, Missouri, provided that some public agency is willing to undertake the $20,000,000 project. The license stipulated that the company was to begin construction by December 1, 1935, but the company has asked for an extension to December 1, 1936. Business leaders have requested the Public Works Administration to take over the project and a formal application for $15,000,000 was made.

•

Bare Neutral Wiring Wins Committee Recognition

Earlier recommendation by the special committee that bare neutral wiring be given no further recognition has been reversed at a recent meeting of the A.S.A. electrical committee. A majority favored limited recognition in the 1935 code for special circuits supplying ranges and water heaters. Regulatory bodies can consent to further installations aimed at developing the technique. Bare neutral wiring may not, however, be extension of existing insulated wiring. Switch or fuse is prohibited wherever it breaks the continuity of the neutral conductor. In taking this action due regard was had for the official opposition to bare neutral by plumbers, water works officials and sanitary engineers. This decision now goes to the N.F.P.A. sponsor at the Atlanta meeting May 13.

The electrical committee also recommended general editorial revision of the National Electrical Code so as to incorporate in general rules the aim or purpose of the detailed requirements. Such fundamental principles would require far less frequent revision than the specific rules. Some specifications for particular materials and equipment could be eliminated. A committee will prepare this new draft for detailed analysis at the 1936 meeting for 1937 publication. This is the outcome of the proposal by the electric light and power group representatives that the code be revamped in structure and objective (ELECTRICAL WORLD, September 15, 1934, page 39).

COMING MEETINGS

Northwest Electric Light and Power Association—Engineering and operation section, Washington Hotel, Seattle, Wash., May 9-11. William S. Hill, Grays Harbor Railway & Light Company, Aberdeen, Wash.

National Electrical Manufacturers Association — Spring meeting, The Homestead, Hot Springs, Va., May 20-23. W. J. Donald, 155 East 44th Street, New York.

National Battery Manufacturers Association — Spring meeting, Hollenden Hotel, Cleveland, Ohio, May 22-23. W. J. Parker, commissioner, 7 East 44th Street, New York.

Edison Electric Institute—Atlantic City, N. J., June 3-6. B. F. Weadock, 420 Lexington Avenue, New York.

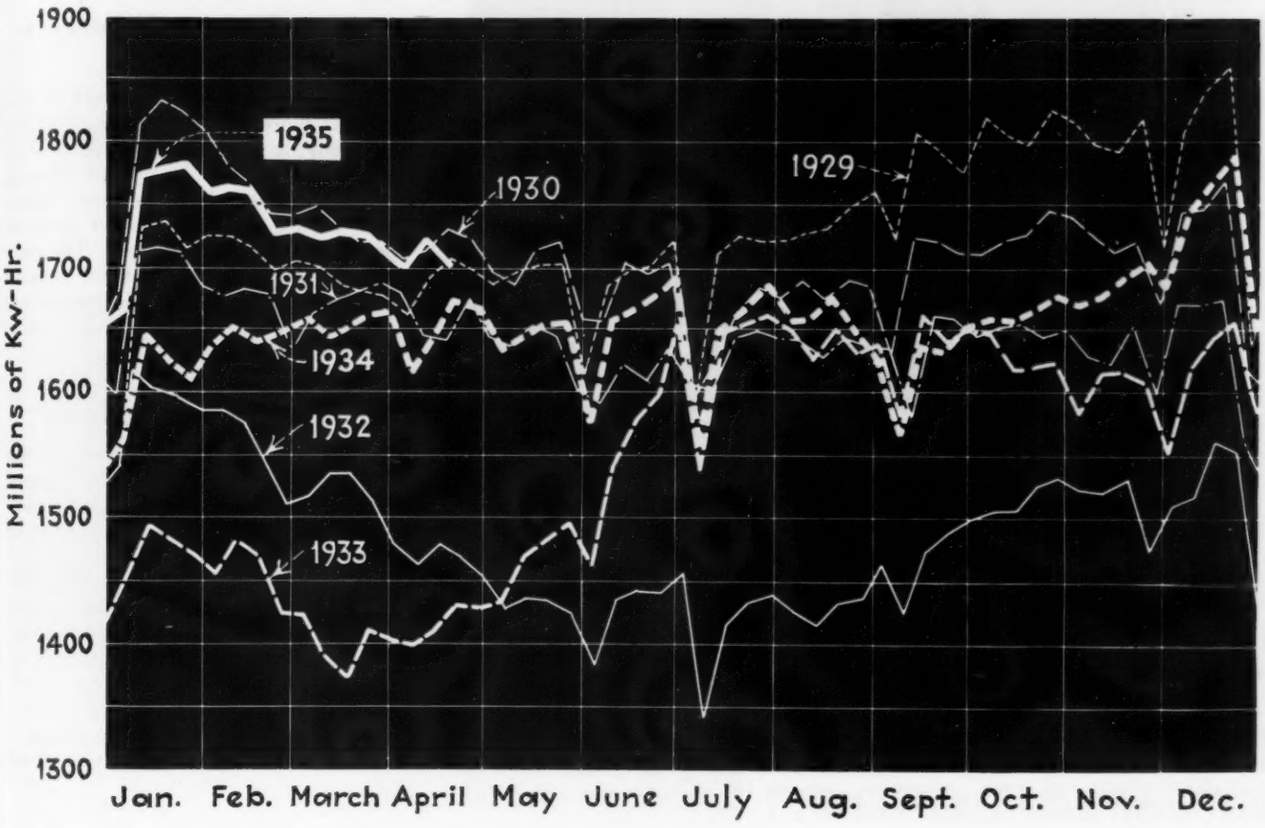
American Society of Mechanical Engineers—Semi-annual meeting, Cincinnati, Ohio, June 19-21. C. E. Davies, 29 West 39th Street, New York.

American Institute of Electrical Engineers — Summer convention, Ithaca, N. Y., June 24-28. H. H. Henline, national secretary, 33 West 39th Street, New York.

American Society for Testing Materials—Annual meeting, Book-Cadillac Hotel, Detroit, Mich., June 24-28. R. E. Hess, assistant secretary, 260 South Broad Street, Philadelphia, Pa.

Canadian Electrical Association — Annual meeting, Algonquin Hotel, St. Andrews-by-the-Sea, N. B., June 26-28. B. C. Fairchild, secretary, 409 Power Building, Montreal, Que.

Output Again Breaks Record, Then Slips



After rising above all previous records for the second week in April, with a production of 1,725,352,000 kw.-hr., the generation of energy in central stations during the week ended April 20 decreased to 1,701,945,000 kw.-hr. and thereby fell below the corresponding figures for both 1929 and 1930. Compared with last year there was a gain, however, of 1.7 per cent, according to statistics announced by the Edison Electric Institute.

Despite the decrease, production was slightly greater than in the week of April 6. The loss relative to the peak year was due more to an unseasonable rise at that time than to any abnormal decline this year.

Regionally, the most pronounced indications of recovery continue to come from the central industrial and Rocky Mountain divisions, where the present rise over 1934 follows gains of 20 per cent or more last year compared with 1933. In contrast, the loss of 12.3 per cent on the Coast brings operations approximately down to the level of 1933. New England fell slightly under 1934.

Weekly Output, Millions of Kw.-Hr.

1935	1934	1933
Apr. 20...1,702	Apr. 21...1,673	Apr. 22...1,431
Apr. 13...1,725	Apr. 14...1,642	Apr. 15...1,410
Apr. 6...1,700	Apr. 7...1,617	Apr. 8...1,399
Mar. 30...1,713	Mar. 31...1,666	Apr. 1...1,402
Mar. 23...1,725	Mar. 24...1,658	Mar. 25...1,410
Mar. 16...1,728	Mar. 17...1,650	Mar. 18...1,375

Per Cent Change from Previous Year

Region	Week ended Apr. 20	Apr. 13	Apr. 6
New England	— 0.3	+ 2.1	+ 3.1
Middle Atlantic	+ 4.3	+ 7.8	+ 4.5
Central Industrial	+ 5.3	+ 7.4	+ 6.9
West Central	+ 3.3	+ 7.0	+ 7.7
Southern States	+ 6.1	+ 7.2	+ 8.1
Rocky Mountain	+13.8	+17.6	+17.2
Pacific Coast	—12.3	—10.1	— 5.2
United States	+ 1.7	+ 5.1	+ 5.2

General Electric Profit Increases 37 per Cent

Sales billed by General Electric Company for the first quarter of 1935 amounted to $40,393,538, compared with $34,935,551 for the same quarter a year ago, an increase of 16 per cent, President Gerard Swope announced to stockholders of the company at their recent annual meeting.

Profit available for dividends on the common stock amounted to $5,390,930 for the first quarter of 1935, compared with $3,921,961 for the first quarter of 1934, an increase of 37 per cent. This is equivalent to 19 cents a share for the 1935 quarter and 14 cents a share for the 1934 quarter. Mr. Swope pointed out that last year a dividend of 15 cents a share was paid on the special stock out of the earnings of the first quarter, while for the first quarter this year there is no such deduction from earnings, as the final payment made upon retirement of the special stock on April 15 was provided for last year. This is equivalent to approximately two cents per share for the quarter on the common stock.

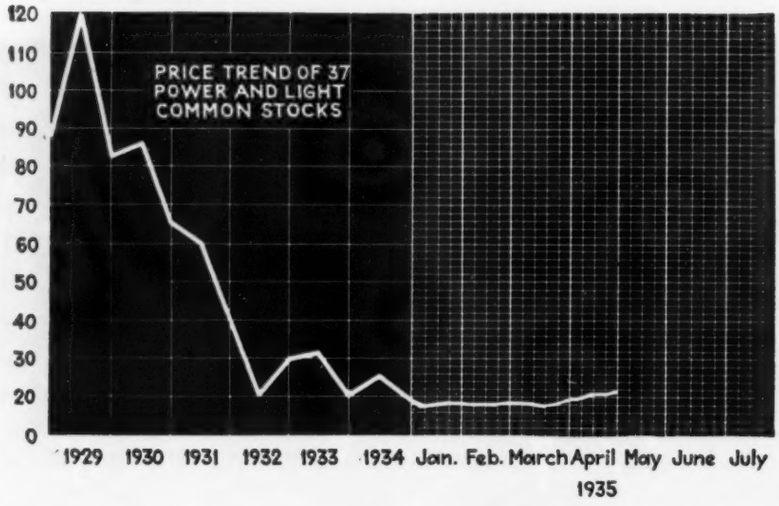
Orders received during the first quarter of 1935 amounted to $49,379,932, compared with $38,148,654 for the same quarter of 1934, a 29 per cent increase.

New York Metal Prices

	Apr. 10, 1935 Cents per Pound	Apr. 24, 193 Cents per Pound
Copper, electrolytic	9.00*	9.00*
Lead, Am. S. & R. Price	3.65	3.75
Antimony	14.00	14.00
Nickel ingot	35.00	35.00
Zinc, spot	4.35	4.45
Tin Straits	49.375	50.75
Aluminum, 99 per cent	19—21	19—21

*Blue Eagle.

Utility Stocks Advance Sharply



Sharing in the general current optimism, light and power stocks rose briskly, many members of this group reaching new highs for the year. "Electrical World" index, 22.0; last week, 20.8.

Utilities Refinancing on Large Scale

Sharing in the nation-wide movement to replace high-interest-bearing bonds with new bonds of lower coupons, several electric light and power companies have recently announced refinancing plans.

Frank D. Comerford, president of the Edison Electric Illuminating Company of Boston, has called a special meeting of stockholders for April 30 to consider the refinancing of short indebtedness of the company. "Money conditions seem to be favorable for refinancing," said Mr. Comerford. "Any such move on our part will have to be approved by stockholders and by the Massachusetts Department of Public Utilities and will have to be registered with the Securities and Exchange Commission in Washington. To save as much time as possible, a meeting of stockholders has been called for April 30 to consider the plans." Heretofore the company has obtained new capital through the sale of stock or of short-term notes, at low interest rates. The notes were always considered temporary financing pending an ultimate sale of shares.

Consolidated Gas, Electric Light & Power Company of Baltimore has arranged for the sale at par of $10,440,000 25-year 3¾ per cent first refunding mortgage sinking fund bonds, series L, to a group of seven insurance companies. While approval of the Public Service Commission of Maryland is required for issuance of the bonds, no registration will be necessary under the Securities Act because of the sale of the entire issue to a limited number of purchasers. When the commission's approval has been received the company intends to call its 4¾ per cent, series G, first refunding mortgage sinking fund bonds, of which $9,943,000 is outstanding.

Rumors of refinancing by the Commonwealth Edison Company have been current for several weeks, but no official announcement has been made by executives of the company.

•

Crocker-Wheeler Shipments Increase 40 per Cent

Shipments of completed work by the Crocker-Wheeler Electric Manufacturing Company in the first three months of 1935 were 40 per cent greater than in the similar period of last year. Bookings during the same period were 60 per cent ahead of last year. The company operated in the black for each of the first three months of the current year, indicating a marked improvement over a year ago.

•

$73,000,000 Issue Offered

Offering was made this week of the new issue of $73,000,000 refunding mortgage gold bonds of the Southern California Edison Company, Ltd., series of 3¾s, due 1960, the largest single issue thus far registered under the Securities Act of 1933 (ELECTRICAL WORLD, April 13, page 50). The issue attracted considerable attention at the time of its registration not only because of its size but also because of the 3¾ coupon, which reflects the high credit rating of the company. The bonds were offered to investors at 98½ (flat).

Current Earnings Reports

Operating Companies

	1935	1934
Alabama Power (Year to Feb. 28)		
Gross earnings	$15,534,733	$15,588,505
Net balance	511,339	847,085
Consumers Power (Year to Feb. 28)		
Gross earnings	29,009,795	26,102,562
Net balance	3,041,841	2,898,302
Detroit Edison (Year ended Mar. 31)		
Gross earnings	45,708,563	42,745,300
Net balance	5,369,573	6,921,111
Duquesne Light (Year ended Feb. 28)		
Gross earnings	25,692,501	24,208,574
Net balance	10,294,832*	10,564,850*
Georgia Power (Year to Feb. 28)		
Gross earnings	22,278,032	22,194,472
Net balance	1,082,601	1,925,824
Kansas City Pwr. & Lt. (Year ended Feb. 28)		
Gross earnings	14,898,690	14,286,516
Net balance	3,361,284*	3,215,631*
New Orleans Pub. Serv. Inc. (Year ended Feb. 28)		
Gross earnings	15,110,104	14,777,669
Net balance	288,721†	52,516†
Ohio Edison (Year to Feb. 28)		
Gross earnings	15,451,628	14,476,593
Net balance	1,478,625	1,263,989
Puget SoundPwr. & Lt. (Year ended Jan. 31)		
Gross earnings	13,276,070	12,621,803
Net balance	1,399,857†	1,405,652†
Tennessee Elec. Pwr. (Year to Feb. 28)		
Gross earnings	12,493,524	11,556,226
Net balance	353,723	384,996
Virginia Elec. & Pwr. (Year ended Jan. 31)		
Gross earnings	15,171,353	14,656,186
Net balance	1,513,702	1,798,500

Holding Companies

	1935	1934
Amer. Gas & Elec. & subs. (Year to Feb. 28)		
Gross earnings	$68,458,624	$64,070,060
Net balance	7,799,296	7,566,112
Amer. Pwr. & Lt. & subs. (Year ended Jan. 31)		
Gross earnings	76,955,544	72,822,258
Net balance	4,266,008	3,724,864
American Water Works & Elec. & subs. (Year ended Feb. 28)		
Gross earnings	46,475,251	43,222,468
Net balance	1,700,645	2,356,496
Commonwealth & South. & subs. (Year ended Feb. 28)		
Gross earnings	116,243,456	109,415,786
Net balance	1,236,074†	824,637†
Elec. Pwr. & Lt. & subs. (Year ended Jan. 31)		
Gross earnings	75,070,413	67,848,710
Net balance	159,023	2,206,752†
Engineers Pub. Serv. & subs. (Year ended Feb. 28)		
Gross earnings	44,617,259	42,486,564
Net balance	960,170	1,146,100
National Pwr. & Lt. & subs. (Year ended Jan. 31)		
Gross earnings	71,844,303	68,529,017
Net balance	6,403,291	6,474,667
Philadelphia Co. & subs. (Year ended Feb. 28)		
Gross earnings	47,665,345	45,939,736
Net balance	7,732,981*	7,684,398*
Public Service Corp. of N. J. & subs. (Year ended Feb. 28)		
Gross earnings	120,449,340	117,329,215
Net balance	24,943,499*	26,816,642*

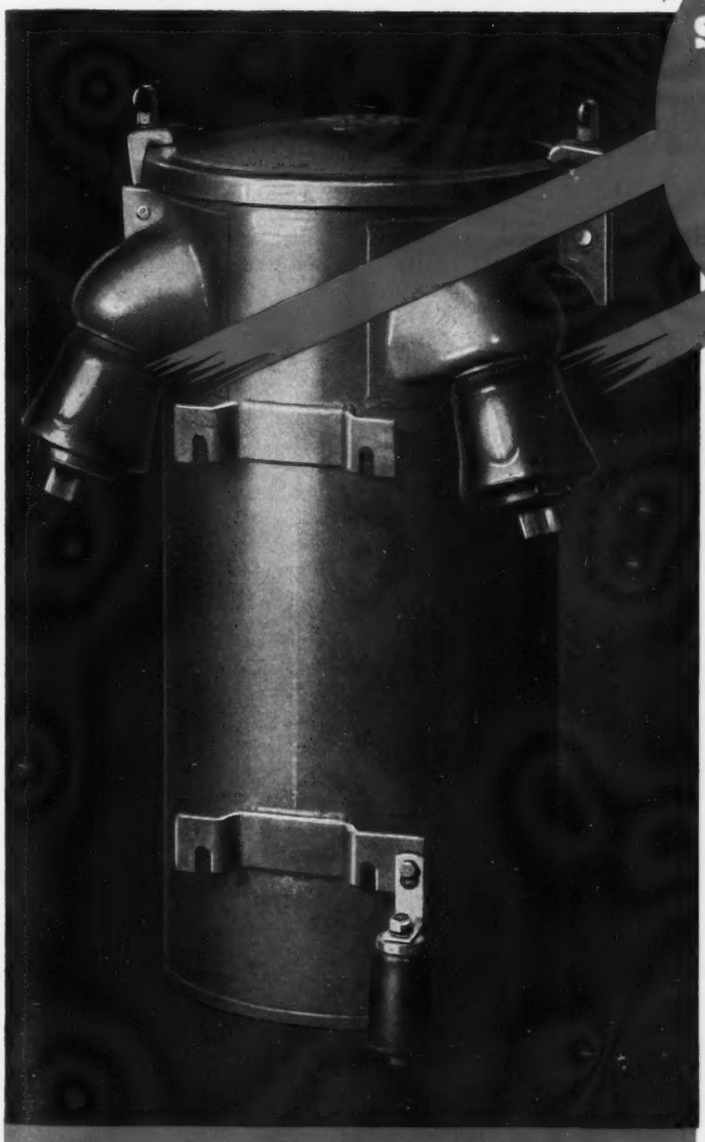
*Available for all dividends. †Deficit.

Gross earnings—(Operating Companies) Gross operating revenue. (Holding Companies) Gross operating revenue plus other income. Net balance—Balance available from income for common stock dividends.

Now

The New G-E Distribution Transformer

with SELF-CONTAINED LIGHTNING PROTECTION by



Added Features
ELECTRICALLY NEW INTERIORS
NEW MECHANICAL STRUCTURES
NEW CLAMP-TERMINAL BUSHINGS
NEW TANK FINISHES

TRUE VALVE-TYPE LIGHTNING ARRESTERS

THROUGH its self-contained bushing-arresters, this transformer reduces installation costs and at the same time meets every requirement of modern lightning protection. The arresters, of the true valve type, utilizing Thyrite, will help you to provide the highest standard of service.

NOTE THESE FEATURES

1. With this form of protection, surge stresses imposed on the transformer are limited to only 25 to 35 per cent of the impulse strength of the transformer.
2. Arrester ground leads can either be connected to the transformer secondary neutral, providing direct interconnection, or connected to the tank, which in turn, can be grounded either directly or through an isolating gap. This gives you the choice of several methods of lightning protection.
3. The characteristics of the bushing-arrester are such that it is unnecessary to make any changes in your primary fusing practice.

The new transformer is available in sizes 100 kv-a. and smaller, for 2400/4160 gr. Y- and 4800/8320 gr. Y-volt circuits. Ask for descriptive bulletin GEA-2077. General Electric, Dept. 6L-201, Schenectady, N. Y.

300-20

GENERAL ELECTRIC

Bonneville Commission Submits Power Report

Two reports, one signed by a majority of four, the other by a minority of three members of the Bonneville Commission of the State of Oregon, are bound in the recently printed report of that commission relating to prospective uses of the power developed at the federal project on the Columbia River at Bonneville, near Portland.

The two reports diverge on the kind of use most likely to absorb Bonneville power and on the manner of distributing it. The majority report finds that the best chance of economic utilization lies in attracting heavy energy-consuming industries to a point near the dam site; the minority advocates state-wide distribution over state-owned transmission lines.

The majority report defines the market area most likely to be affected by Bonneville and analyzes the power supply and use in that area, finding a substantial surplus capacity over present needs. In seeking economic uses, the report analyzes domestic and industrial possibilities and irrigation. In the domestic field it finds average annual use in the market area equals 1,110 kw.-hr., against the national average of 604 kw.-hr., and concludes that the domestic market does not offer a particularly promising field for the consumption of a large portion of Bonneville power.

The most promising field for economic utilization of Bonneville power is found to be in the heavy power-consuming industries such as metals, pulp and paper, and chemicals. The existence of certain raw materials, tidewater transportation at the dam site and other favorable factors are balanced against distance from prospective markets for the finished product and other unfavorable factors in the discussion of prospective uses in these three major industries.

Promotional rate plan urged

The report recommended that the federal government be urged to construct a transmission line from Bonneville to Portland and to announce as soon as possible promotional rates necessary to attract heavy industries.

The minority report reached the conclusion that the largest potential market for Bonneville power is in the homes and farms of Oregon, and that the next largest market is in the light industry widely scattered throughout the state. It concurred with the majority report that a very important future market is in the heavy electric base industries and chemicals. The report advocated a state-owned-and-operated transmission network covering the entire state, and an interstate network constructed by the federal government.

Following the issuance of the report, a subcommittee of the Oregon Planning Council, affiliated with the National Resources Board, passed a resolution recommending further surveys, investigations and studies to determine the most economic and beneficial means of distributing Bonneville power.

•

Utility Franchise Amendment Defeated in Los Angeles

The proposed city charter amendment which would permit the granting of a 35-year franchise to the Los Angeles Gas & Electric Corporation for 2 per cent of its gross receipts was defeated by Los Angeles, Calif., voters in a municipal primary election held April 2. The complete unofficial vote was 80,380 for and 174,970 against the proposal.

•

Load Building Discussed at Vancouver Meeting

Building load by merchandising on low terms over a long-time period was the principal point of discussion at the tenth annual conference of the business development section of the Northwest Electric Light and Power Association, held recently at Vancouver, B. C.

The subject was introduced by W. T. Christy, Edison General Electric Appliance Company, Atlanta, Ga., who told of the 1934 load building results of the Tennessee Electric Power Company, Alabama Power Company and Georgia Power Company in line with the E.H.F.A. program in the Tennessee Valley. Mr. Christy attributed the success of these companies in substantially increasing average domestic use during 1934 to executive interest in the load-building programs and to the long-term offers on the purchase of appliances.

In the consideration of promoting water-heating load three methods being successfully used in the Northwest territory were discussed. R. B. McElroy, Washington Water Power Company, and Orr E. Crites, Portland General Electric Company, each explained the methods used by their respective companies in promoting this load.

In discussing methods for promoting refrigerator load, L. W. Brainard, Idaho Power Company, stated his own merchandising program was based on the premise that best results would be secured if the company remained active in the market, regulating the intensity of its activity according to the activity of and results secured by other dealers.

The subject of small appliance promotion was covered by J. A. Lockhart, Pacific Power & Light Company.

In the program of the commercial and industrial sales bureau conducted by O. C. Mayer, Idaho Power Company, unfavorable competitive factors met with in developing commercial cooking load were discussed by A. K. Gaylord, Northwestern Electric Company.

The possibilities for increasing the commercial lighting load in the store modernization now taking place under the Federal Housing Act were graphically portrayed in a series of slides shown by L. B. Gawan, Utah Power & Light Company.

In the industrial power field Thomas M. Gibbes, Puget Sound Power & Light Company, introduced the subject of how to obtain small and large industrial heating loads, touching on the types of rates needed to obtain these loads, and the electric melting of brass and iron, and a discussion of competition with the small high-speed Diesel engine.

H. C. Bender, Washington Water Power Company, chairman air-conditioning committee, told of accomplishments in this field during the past year, and Thomas J. Mellon, North West Electric Company, Seattle, brought out the possibility of securing profitable electric heating business, stressing the auxiliary heating field, in connection with the promotion of air conditioning.

•

North Platte Project Suit

Petition by the State of Wyoming for the dismissal of the suit brought against it by the State of Nebraska, involving ascertainment of the equitable apportionment of the waters of the North Platte River as between the two states, has been refused by the Supreme Court of the United States. An injunction against further use of water for the Casper-Alcova and Seminole reservoir projects is sought.

•

Utility Tax Upheld

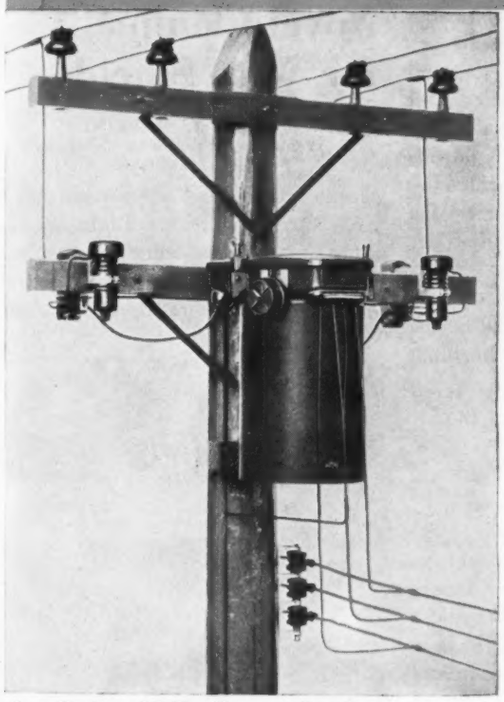
New York City's tax of 1½ per cent on the gross income of public utility corporations was recently upheld as constitutional in a three to two decision by the Appellate Division of the Supreme Court. The court dismissed a test suit brought by the New York Steam Corporation, subsidiary of the Consolidated Gas Company, to recover $12,100.96 paid under the tax.

•

To Electrify Brazil Road

Contract, involving £3,000,000 ($15,000,000), has been awarded the Metropolitan-Vickers Company, Manchester, England, for the electrification of part of the Central Railroad of Brazil. About 93 miles of railroad will be electrified, including a busy suburban section between Rio de Janeiro and Deodoro and 31 miles of sidings.

COMPLETE LIGHTNING PROTECTION ....from the Generator to the Meter



Installation of G-E pellet-type distribution arresters with arrester ground "interconnected" to secondary neutral

Modern Lightning Protective Equipment for Every Part of the Modern Electric System

Protect Your Distribution Transformers

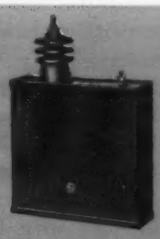
THE economic value of lightning protection for every distribution transformer is well recognized in modern operating practice. Valve-type arresters installed with "interconnection" at every transformer provide practical immunity from transformer failures, primary-fuse blowing, and service interruptions by lightning. They also increase the security of the secondary against primary power current.

G-E distribution arresters have established operating records in protective efficiency that are unsurpassed. Exacting tests in both the laboratory and the field confirm the excellence of their impulse protective characteristics. They assure much lower stresses on your transformers. This means *better protection*—a distinct benefit realized in the more positive preservation of transformer strength and service continuity throughout severe lightning conditions.

For complete information, address the nearest G-E sales office or General Electric, Dept. 6R-201, Schenectady, N. Y.

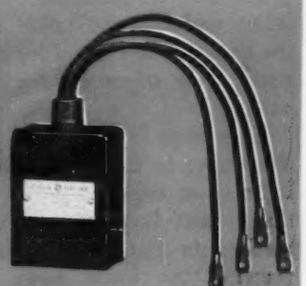
Station-type Thyrite arresters will protect power transformers and station apparatus

Expulsion protective gaps will prevent lightning flashovers and outages on transmission lines



Special protective capacitors and station-type Thyrite arresters will protect both major and turn insulations throughout the windings of a-c. rotating machines

Thyrite meter protectors will prevent lightning damage to watthour meters on exposed secondary circuits



330-241

GENERAL ELECTRIC

Testing Cable Joints Under Gas Pressure

To facilitate testing cable joints for mechanical leaks, the distribution department of the Boston Edison Company has assembled kits to utilize carbon dioxide gas under pressure for this purpose. The gas tanks contain about 4 lb. under a pressure of several hundred pounds per square inch and

Gas supply equipment for pressure testing of compound filled joints

the gas is piped through a reducing valve into a hose line at about 15 lb. per square inch. Lead sleeves wiped on all underground transmission line joints and on multiple joints on all other underground cable systems of the company are tested for tightness as soon as the wipes and the sleeve have cooled.

The sleeve is prepared by making a V-opening in the sleeve with a sharp knife at an angle of about 45 deg., so that a seat is provided for later reseating the flap and sealing in. By drawing the knife away from the sleeve as it cuts, the lead flap is drawn with it and the sleeve is not depressed. The hose and a Star Brass clamp with rubber washer and opening to admit the delivery line connection are then attached to the sleeve and gas admitted to the compound-filled joint. The supply is shut off from the tank and soapsuds used to indicate the location of leaks, if any. A leak at the edge of the sheath is usually indicated by the formation of a large bubble. A porous condition of the solder is revealed by a series of small bubbles over the affected area. One outfit is used per truck, and two splicers and two helpers per truck are normally scheduled to increase production and route the work in a particular neighborhood most advantageously.

•

Life of Outdoor Substation Fences

How much replacement and maintenance are needed to keep fences around outdoor electrical equipment in serviceable condition? This is a question that prompted one company to analyze the durability of different metals used in mesh fences. All samples had the same initial dimensions.

Tests in one place exposed to weather and fumes from coal smoke, smelters, chemical plants, etc., displayed the relative depreciation shown in column A in the following table:

Material	Weight Lost in 4½ Years (Per Cent)	
Service	A	B
Ingot iron	74	29.6
Low-copper steel	67	13.9
Copper-bearing steel ..	42	8.2
Copperweld steel	2.1	...

Under less severe exposure, but still outdoors, these same materials had a different order of depreciation shown in column B. Aluminum-alloy wire of the same dimensions as other samples, under the worst conditions represented by column A, increased its weight 1½ per cent in 20 months. Contact of dissimilar metals under exposed conditions (e.g., fence wire in contact with fence posts) always stimulates corrosion, this being greatest in the tests run where copperweld wire came in contact with galvanized posts.

The life of ordinary zinc coating on galvanized wire was found to be 4½ years under the conditions studied, although longer life may be expected with higher quality galvanizing.

Novel Clamp for Wire Shields

By C. J. MARONI
Westchester Lighting Company
Mount Vernon, N. Y.

Where overhead wires pass through trees the Westchester Lighting Company favors protecting the insulation against abrasion instead of extreme trimming of branches to avoid

Split hardwood shield clamped around insulated conductor with novel clamp avoids tree grounds

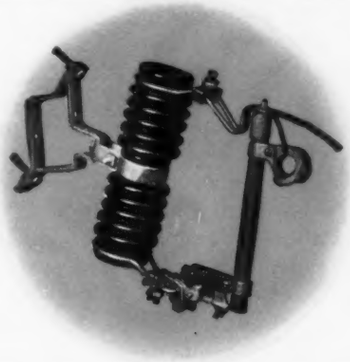
grounds. Such trimming is avoided because permission is sometimes difficult to obtain, is expensive to do properly and maintain, and in some cases necessitates the removal of the major part of the tree.

For protecting the insulation in such places split hardwood shields 4 ft. long are clamped around the conductor where abrasion is imminent. The clamps, of which three are used per section, greatly facilitate application of the split hardwood shield. With the split shield held around the conductor with one hand each clamp can be easily applied with the other hand. The rack-grooved tongue of the clamp when slid under the pivoted worm screw locks in place, so that the clamp will remain in position until the worm screw is tightened with a screwdriver. When this is done the tongue draws up circumferentially, clamping the split hardwood to the conductor. The

IT WILL PAY YOU TO

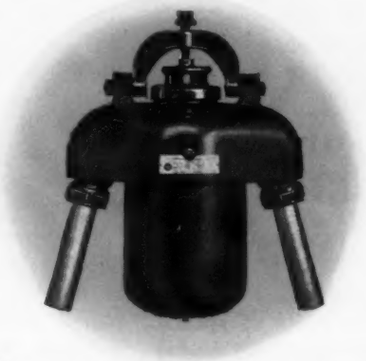
Look into G-E Cutouts

1 G-E enclosed, expulsion-type fuse cutouts, since their introduction seven years ago, have thoroughly demonstrated their ability to stand up under the hardest kind of service. They provide maximum safety for the lineman.



2 G-E open fuse cutouts with drop-out fuse holders will save you time and money in detecting blown fuses and in restoring service. Their simplified design makes fuse renewal easy and reduces the costs of maintenance to the minimum.

3 G-E 2-in-1, enclosed indicating and drop-out fuse cutouts give you your choice of two methods of indication—by partial opening of the door, as shown here, or complete opening. Safety, ease of fuse renewal, and positive operation are other features of this cutout.



4 G-E oil fuse cutouts will protect your service and equipment where high speed and high interrupting ability are required. They are quiet in operation and may be used indoors and where explosive gases are present. The subway type, shown above, will operate submerged.

G-E FUSE CUTOUTS have high mechanical and electrical strength. Used with G-E fuse links, they give full-range, short-circuit protection for distribution transformers. Their liberal factors of safety have been effectively demonstrated by short-circuit tests, flashover and puncture tests, A.I.E.E. thermal and dielectric tests, as well as by service records and other tests.

The standards set as a result of these tests are maintained by constant laboratory supervision of materials and continued testing of parts and complete cutouts.

Ask your G-E representative for further information. General Electric, Dept. 6A-201, Schenectady, N.Y.

340-15

GENERAL ELECTRIC

pressure exerted by this tightening is sufficient to prevent the hardwood from sliding on the conductor, thus eliminating the necessity of tying the hardwood to the conductor. The clamps can be removed easily by merely loosening the screw, flipping it back and withdrawing the tongue.

Some idea of the extent of usefulness of these novel clamps is indicated by the fact that approximately 18,000 have been applied to this purpose in the last year. By standardizing on an elliptical-shaped groove in each half of the hardwood shield one size hardwood is used for all insulated conductors and one hose clamp for 2 in. to 2⅝ in. outside diameter is kept in stock. It is known as the "Grip-Tite" clamp, made by Otto Bieber, Inc., New York, N. Y. The clamps are made of electro-galvanized, cold-rolled ¼ hard steel and withstand the weather very well, judging from experience so far. Being constructed of inseparable parts, there are no nuts or bolts to lose, no special tools are required, and the clamps are easily installed and removed and can be used repeatedly.

It appears that similar or slightly modified clamps would greatly facilitate clamping of split-wood guards to guy wires, clamping split-fiber conduit around conductors on crossarms or down poles, attaching ground wires to ground rods or water pipes, etc.

•

High-Pressure Valve Repaired at Low Cost

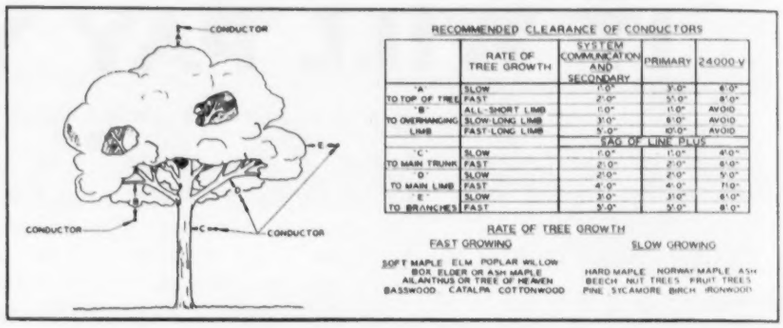
By C. M. TAYLOR
Lincoln Electric Company, Cleveland, Ohio

With high-pressure steam and hot-water valves having seats of special metal screwed into the valve bodies leaks frequently develop in the threaded connection. Once started, such leaks become larger rapidly as the steam or hot water, rushing through, erodes the softer metal of the housing. In the plant of a large Midwestern power company certain valves were giving this trouble and either had to be replaced pretty soon, at an approximate cost of $400 each, or some means of repair had to be found. By arc welding valves leakless operation was obtained and the cost per valve was only $20. The old threads in the valve bodies were machined. Then a sufficient thickness of metal was deposited in the ring by arc welding and the ring was remachined and rethreaded for reception of the valve seat. To the direct saving of about $380 per valve must be added the important but indefinite value of the time saved by avoiding complete replacement.

Another instance of the same kind of valve repairing involved a 6-in. throttle valve in the same plant. All previous efforts to stop the leaks between the alloy seat and body of the valve had failed. The trouble was finally eliminated by making the seats of forged stainless steel and welding them into the body with a special electrode. A new valve would have cost from $750 to $1,000. The cost of the new seats plus installation was only $60. High-pressure valves up to 14 in. in size are regularly rehabilitated in this manner at costs from $20 to $30. This is worth-while economy when it is considered that replacement of a valve like this might cost up to $1,500.

Cast-steel valves, which frequently develop leaks because of sand holes in the body of the castings, are repaired with great economy by arc welding. The valves in one plant had a replacement value of $3,700. Arc welding repaired them for $500, a saving of $3,200. Another important maintenance use of arc welding is that of preventing the cutting action of steam on seat faces and disks of valves by applying a hard surfacing material.

Tree Clearances in Detroit



RECOMMENDED CLEARANCE OF CONDUCTORS

	RATE OF TREE GROWTH	SYSTEM COMMUNICATION AND SECONDARY	PRIMARY	24000 V
"A" TO TOP OF TREE	SLOW	1'-0"	3'-0"	6'-0"
	FAST	2'-0"	5'-0"	8'-0"
"B" TO OVERHANGING LIMB	ALL-SHORT LIMB	1'-0"	1'-0"	AVOID
	SLOW-LONG LIMB	3'-0"	6'-0"	AVOID
	FAST-LONG LIMB	5'-0"	10'-0"	AVOID
		SAG OF LINE PLUS		
"C" TO MAIN TRUNK	SLOW	1'-0"	1'-0"	4'-0"
	FAST	2'-0"	2'-0"	6'-0"
"D" TO MAIN LIMB	SLOW	2'-0"	2'-0"	5'-0"
	FAST	4'-0"	4'-0"	7'-0"
"E" TO BRANCHES	SLOW	3'-0"	3'-0"	6'-0"
	FAST	5'-0"	5'-0"	8'-0"

RATE OF TREE GROWTH

FAST GROWING: SOFT MAPLE, ELM, POPLAR, WILLOW, BOX ELDER OR ASH MAPLE, AILANTHUS OR TREE OF HEAVEN, BASSWOOD, CATALPA, COTTONWOOD

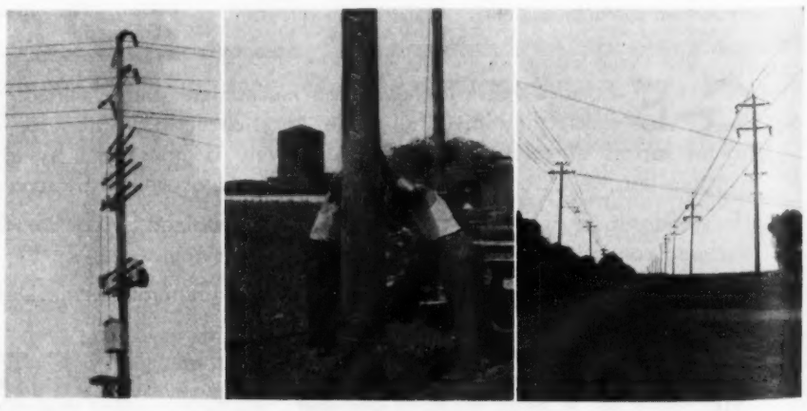
SLOW GROWING: HARD MAPLE, NORWAY MAPLE, ASH, BEECH, NUT TREES, FRUIT TREES, PINE, SYCAMORE, BIRCH, IRONWOOD

The Detroit Edison Company uses the above definite instructions for clearing trees by conductors.

•

Live 66-Kv. Line Moved Sixteen Feet

Recently the Toledo Edison Company found it necessary to move seventeen poles carrying a 66-kv. circuit 16 ft. to one side while the circuit was in service. This was accomplished by drilling the new holes, trenching about 4 ft. deep from the pole to the new hole and placing a timber horizontally in the trench. The guy ropes were attached near the top of the pole and the pole hoisted by the truck. A cable from the truck windlass then pulled the pole, sliding on the timber, to the new location, where it was simply set down in its new position. Everything proceeded without mishap, continuity of service was maintained and the cost was only a fraction of that of the usual method.



Poles skidded in trench to move live line

RECLOSES the circuit automatically.

A built-in time delay device can easily be adjusted to cut in the following fuse instantaneously or after any interval up to two seconds.

All cartridges are in the up or closed position when the fuse links are intact. A blown fuse can be located immediately.

Rugged, dependable construction. Foolproof time delay device.

Available for 100 amperes capacity, in two- and three-unit designs, for voltage ratings up to 15,000 volts.

See a sample—a demonstration.

LINE MATERIAL CO

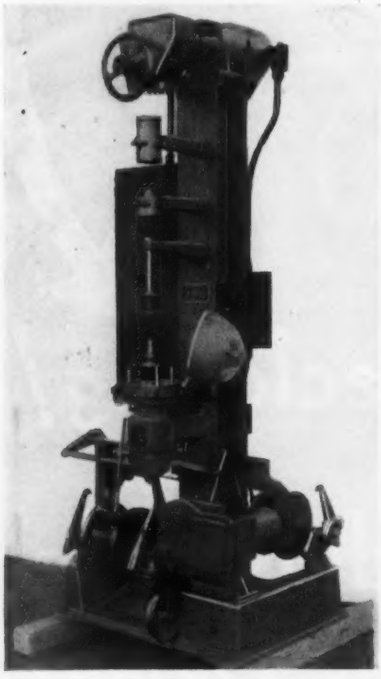
SOUTH MILWAUKEE, WISCONSIN, U. S. A.

POWER AT WORK IN INDUSTRY

LIGHTING • MOTORS • CONTROL • HEAT • AIR CONDITIONING

SynchronizedControl Avoids Backlash

Application of cellulous acetate and ¾-mil paper as a dielectric on wire has developed a problem for which electrical control is particularly adapted. Thin strips of dielectric material must be served around a small wire in such a manner that uniform application will result, while the wire is in motion between the pay-off and take-up reels. This requires synchronism of the serving head with the speed of the wire.



Ward Leonard Electric Company

Machine serves insulation on moving wire

Slippage of belt-driven machines and backlash of mechanical drives between the capstan, flyer and take-up could not be tolerated, declared one manufacturer. Both objections were avoided by the use of individual, direct motor drives which lock the capstan and flyer in electrical synchronism. Speed and tension control were provided by rheostats connected in the secondaries of the capstan and take-up motors. After the rheostats are set for the given size of wire and width of serving, the operation can be controlled by the push-button station. Further control is provided by definite-time-limit acceleration for starting the motors smoothly and in step. The electric drive and control results in a smooth, steady drive which minimizes breaks when serving the material, and thereby reduces interruptions to production.

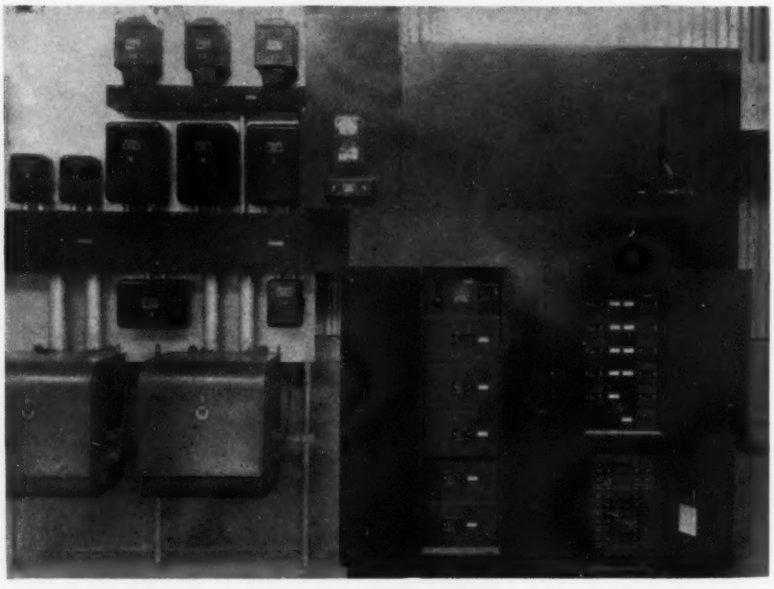
•

Unit Figures for Estimates

Translating data on air-conditioned office buildings in San Antonio, Tex., and Phoenix, Ariz., to Philadelphia conditions, it is reported that the average installation cost is $0.73 per square foot of rentable space. Approximately 375 sq.ft. of rentable space can be conditioned per hour of refrigeration. Preliminary calculations of the air-conditioning load for commercial installations can be based on 3.5 B.t.u. per cubic foot per hour for small offices, 4.5 B.t.u.'s for stores and 5 B.t.u.'s for restaurants.

Since 1 ton of refrigeration can extract 1,200 B.t.u.'s of heat per hour, large mechanical compressors will have a demand of about 1.1 kw. per ton and a water consumption of 2 gal. per minute per ton in Philadelphia. (In summer the wet-bulb temperature there is about 78 deg. F. and condensing water is about 85 deg. F.) A condenser using an air-cooled condenser will require 1.5 kw. per ton. A steam-jet machine uses about 30 lb. of steam per hour per ton and 6 g.p.m. of condensing water per ton. To these figures must be added 0.2 kw. per ton if a central system using airwashers is employed, to cover fan and pump load.

Saves Space and Maintenance



A recent installation made for the Santa Cruz Portland Cement Company at Alameda, Calif., typifies the savings that can be made with modern electrical equipment. By using Deïon no-fuse air circuit breakers, it is reported that the space required for the switchboard was only about one-third that usually allowed for a board of equivalent capacity using conventional equipment. In addition to eliminating the cost of fuse replacements, the new board assures quick restoration of service, in cases of circuit interruption, as the breaker handle assumes a neutral position in clearing overloads and short circuits. The installation was made by the California Electric Company, Ltd.

How TO GET MORE FOR YOUR MONEY

when buying motors . . .

CHECK THE FRAME—This is important, because motor frame sizes are standardized. Thus the frame which has the necessary strength and rigidity with least bulk will allow more room for more copper and iron in stator and rotor. It also will provide larger openings for greater ventilation.

CHECK THE STATOR—Its laminations should be 28-ga. high silicon steel, heat treated, to insure high resistance, low retentivity and perfect insulation. There should be a maximum of iron in the stator section so that there is less idle current. The coil noses of the windings should be extremely short for the most effective use of copper.

CHECK THE INSULATION—It should be permanently pliable—should never dry out or crack. Not only should the insulation be waterproof but also highly resistant to acids, fumes and dirt.

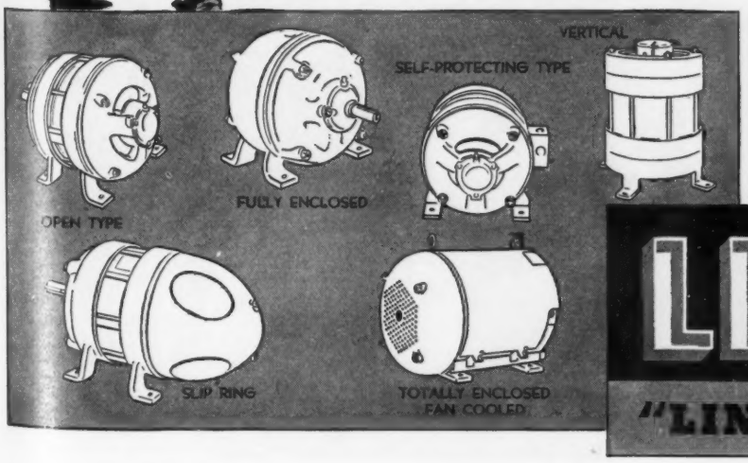
CHECK THE ROTOR—Be sure the laminations are not dependent on the windings to hold them together. The windings should be a single piece of metal to provide a perfect electrical circuit. The rotor shaft should be extra large, accurately machined and ground. Fans should have many steel vanes to whip large volumes of air through motor to insure cool operation.

CHECK THE PERFORMANCE—Motors which have the recommended features of construction will outperform all others. Will deliver extra horsepower without sacrifice of power factor or efficiency. Will give you more dependable service for your money. Will bear the name "Linc-Weld" on the nameplate. The Lincoln Electric Company, Cleveland, Ohio.

M-15

LAD "Congress, it seems, will do nothing about birth control."

POP "Yes, and it's too late for birth control to do any thing about Congress . . . so it gets back again to individual preference . . . just as I put it up to our plant electricians as to what motors I should buy—they all wanted *'Linc-Welds.'* Better they should have what they want than to say, 'You *must* take this and like it'."



LINCOLN

"LINC-WELD" MOTORS

Built-on Light for Card Sorting

A logical but rarely applied by-product of the idea of using localized light to increase efficiency and minimize errors by assisting the work of the eyes consists of a light-box on a bracket mounted at the right side of card sorting machines and covered by

Checking perforated cards by holding them over a translucent screen lighted by foot pedal

a flashed opal glass panel behind which is a 25-watt tubular "Mazda" lamp.

The task of sorting the cards coming from the key-punch machines has formerly been an onerous one. Accuracy of the sorting has been checked in several ways: One way has been to run a needle or heavy wire through the perforations, thus ascertaining that all of one classification are together. Another method has been to hold the cards up to some light source, such as the window or a lighting fixture. Both of these methods are necessarily makeshifts and slow. A sight-check requires that the light source be adequate and convenient to the scene of operations.

Following several experiments, Horton Brockway of the Nela Park statistical department of the General Electric Company developed the present "Sorter-Light" with the aid of the lighting engineers. The light is so arranged that it makes a bright surface on the flashed opal glass, over which the cards are held for checking. Any obstruction in the perforations of the cards quickly reveals an error in sorting. A foot pedal permits switching the light on and off without the operator changing his position and makes possible the use of both hands for holding a pack of tabulating cards.

All of the sorting machines in the statistical department are now equipped with them. As a result, the work has been speeded up, errors decreased and the operator is less fatigued at the end of the day. Office equipment manufacturers to whom the new "Sorter-Light" has been demonstrated are reported to have been so impressed by its possibilities that the near future may see the localized lighting idea applied to many standard pieces of office equipment.

•

Conditioned Air in Silk Mills

Use of synthetic silk has made air conditioning even more necessary than formerly in silk mills, to obtain maximum strength, avoid processing difficulties, permit high machine speeds and avoid limitation of production to territories where the weather conditions are proper.

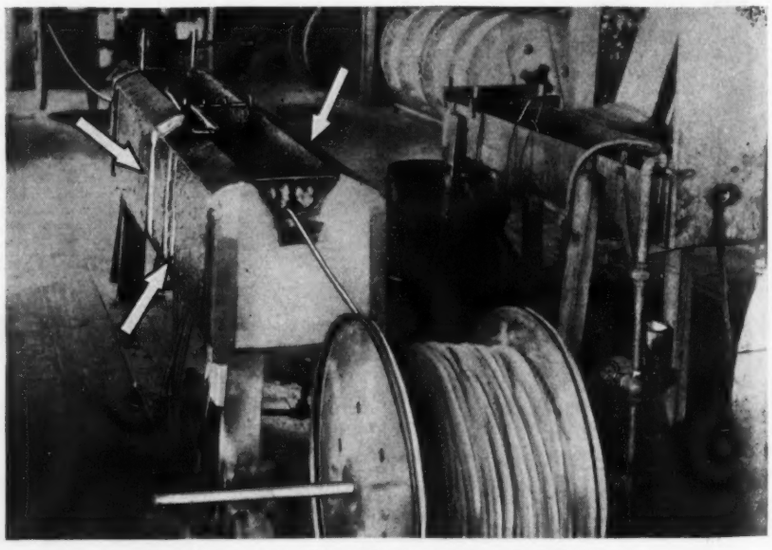
Depending on the building construction and motor horsepower per square foot, the cost of air-conditioning equipment for silk-throwing or rayon mills in Pennsylvania ranges on each side of 56 cents per square foot of mill area and the installed kilowatts for this purpose around 2.17 per 1,000 sq.ft. It has high load factor, as the conditioning equipment is usually run even at night when the mill is not operating. For silk weaving the cost of air-conditioning equipment ranges from 30 cents per square foot (in well-insulated buildings) to 51 cents and the kilowatts installed from 0.14 to 0.49 per 1,000 sq.ft.

Electric Heat Improves Lacquering

For 40 years steam had been used by one manufacturer for all heating needs from water compounds to ovens. With some skepticism, electric heaters were finally given a trial in the ignition cable-lacquering department, three 500-watt strip heaters being installed in a small experimental oven, where they not only immediately improved production but produced better results.

A duplicate of this first tank, used for melting red paraffin, was soon electrified. This was followed by the construction of a small tank for melting waxes and compounds for experimental use. Twelve kilowatts in heaters were installed, split up to put 4 kw. per phase on a three-phase, 220-volt circuit, controlled by three-heat switches, which, between them, therefore, gave nine temperature stops. "The highest temperature ever recorded on this tank has been 550 deg. F., but we know we can go higher," writes the man responsible for converting this equipment over to electric heat. His report goes on to say:

"Our next tank was somewhat larger, using 18 kw. It melted a heavy compound and our heat distribution was changed so that no hot spots occurred through the mass. During all this time new points of advantage were being discovered, and finally a decision was made to convert every one of our eight tanks to electric heat. This has made a total of 102 kw., connected for compound heating alone."



One of the electrified compound tanks

SUPERIOR
REG. U. S. PAT. OFF.

PRODUCTS

+(BAIS-20)

Are

Overall Meter Enclosures
(For Diversion Prevention)

Test Switches and Blocks
(For Meters and Relays)

Sheet Metal Enclosures
(For Electric Apparatus)

Copper and Sheet Metal Specialties
(For Your Special and Specific Needs)

Made by—

An engineering and manufacturing staff that knows how.

In—

A modern factory completely fitted with sheet metal and copper fabricating facilities.

That's our story and how we do stick to it.

THE SUPERIOR SWITCHBOARD AND DEVICES COMPANY
CANTON, OHIO

SUPERIOR
REG. U. S. PAT. OFF.

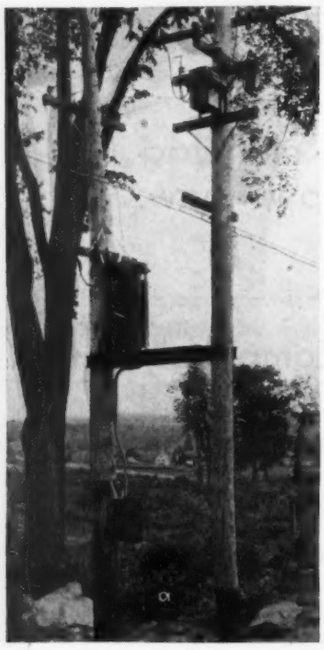
+ Been At It Since 1920

Pole Regulator Cuts Voltage Variation

By F. S. PIPER
Electrical Engineer
Public Service Company of New Hampshire

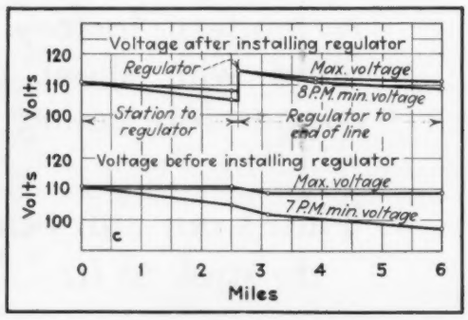
Unavailability of gas and city water in rural areas has resulted in high ratio of range, water-heater and water-pumping load, which in turn accentuates the voltage regulation problem. To meet this situation a pole-mounted automatic induction regulator has been installed at a cost of $1,200 on a 4½-mile single-phase branch feeder at a point approximately 2½ miles from the Hooksett station along a three-phase circuit. Induction regulators at the station had failed to give adequate regulation on the branch while delivering proper voltage at town 2 miles from the station. For this situation the conventional booster transformer and stepping up of the voltage at the bus did not appear feasible.

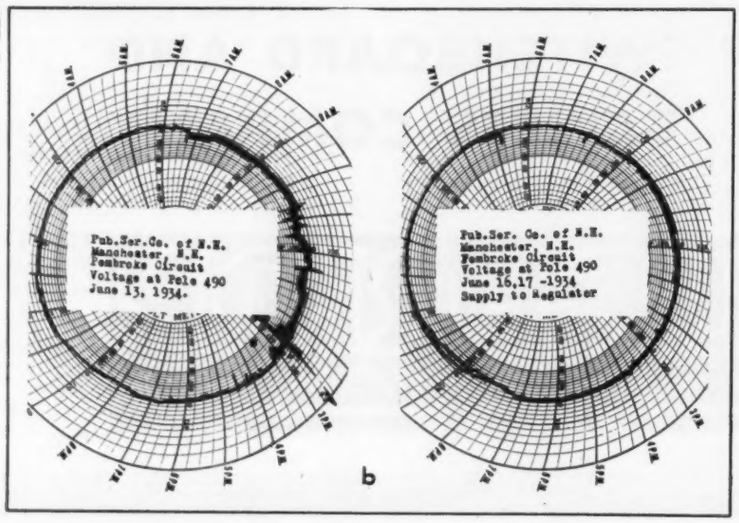
No tests were made to determine the increase in revenue which has attended the higher voltage, but from previous experience with booster transformers an increase of 1 to 1¼ per cent is expected with each 1 per cent of raised voltage.



Pole type regulator improves voltage on long branch line

(a) General Electric pole-mounted regulator has control equipment in weather-proof housing accessible from the ground. Oil switch and arresters at pole top.
(b) Four-volt regulation instead of over 20 volts.
(c) Six-mile line gets improved voltage.





How Strong Is the H-Frame?

By B. E. ELLSWORTH
Engineer Iowa-Nebraska Light & Power Company, Lincoln, Neb.

As soon as a crossarm is installed between two poles to form the H-frame, a complicated structure results. If one pole is larger in diameter than the other it will carry more than its share of the load. The strength of the structure then becomes more nearly the value of the large pole than of the sum of both poles.

The reason for this seeming fallacy is that the crossarm ties the tops of the poles together so the deflection of both poles must be equal. The deflection of a pole varies inversely as the fourth power of its circumference, while the pole strength varies as the cube of its circumference. Therefore, the small pole will be more flexible and shift the load onto the large pole and the large pole will break first. In order to secure the greatest strength possible from the structure the poles should be of equal size. Where this is not possible their relative strengths should be calculated on a basis of deflection rather than by the ordinary method.

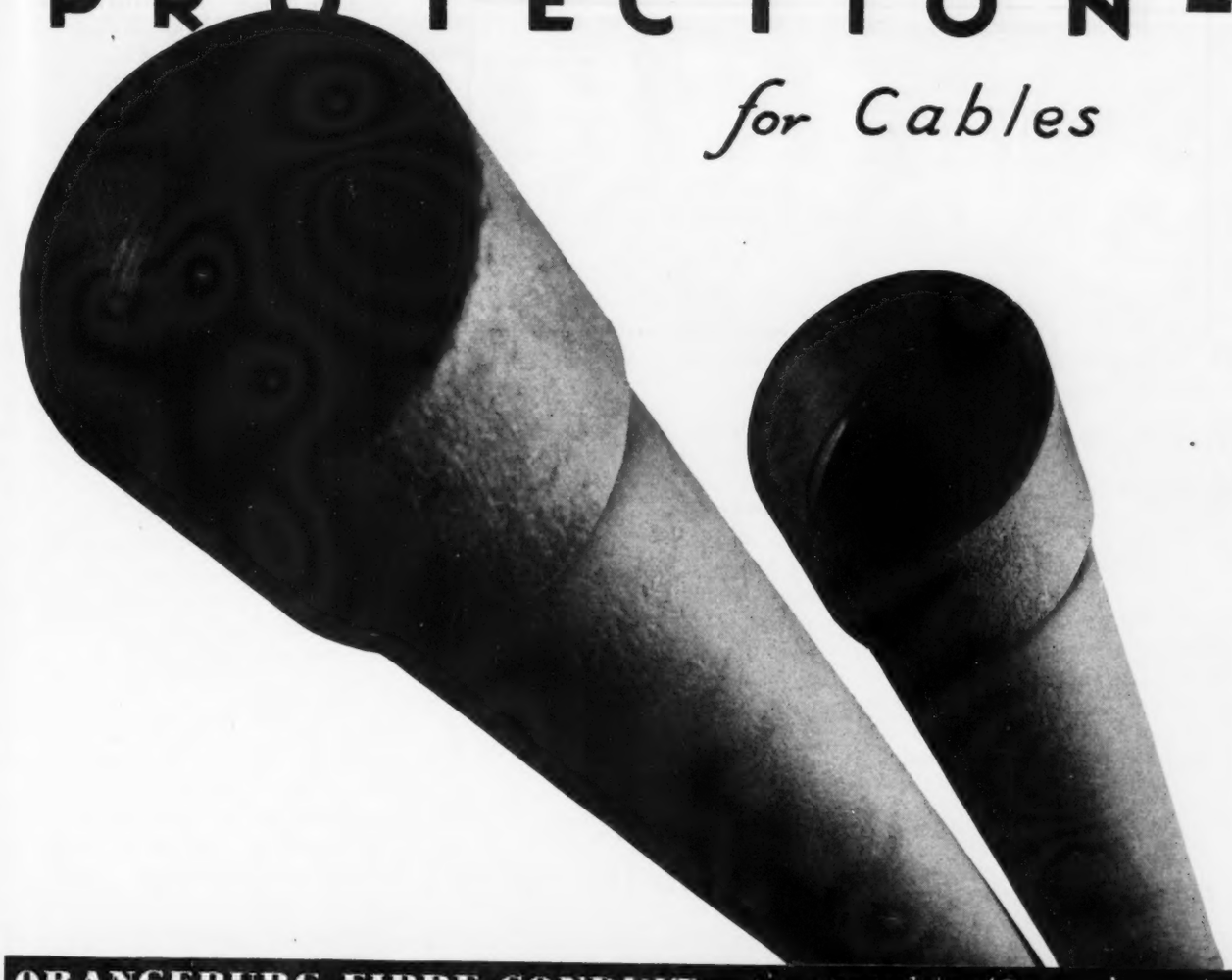
The following formula can be used with fair accuracy to calculate the deflection of a pole:

$$\text{Deflection (in inches)} = \frac{2.3\, L^3\, W\, 10^6}{E\,(C_T^4 + C_B^4)}$$

L is the length of pole above ground in feet.
W is the transverse load at the top of the pole in pounds.
E is the modulus of elasticity (around 1,000,000 for W.R.C.)
C_T is the pole circumference at top in inches.
C_B is the pole circumference at ground line in inches.

This formula was checked with the results secured in seventeen tests made by the Western Red Cedar Association. The average of these tests and the calculated average using the above formula checked within 2 per cent. The variation in wood strengths due to knots and other wood defects may cause a plus or minus 20 per cent error in any one specimen.

PROTECTION—
for Cables



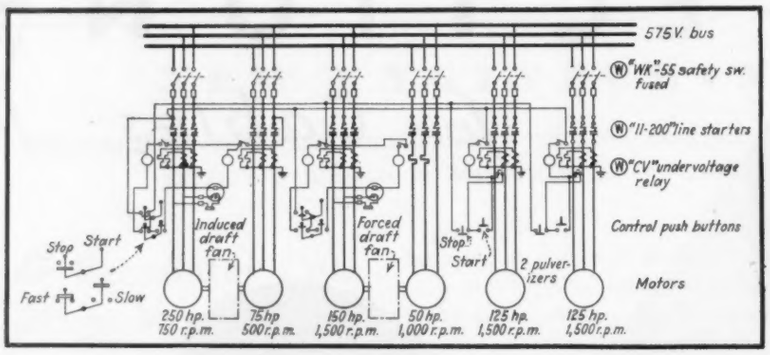
ORANGEBURG FIBRE CONDUIT — *time-tested in 42 years' service*

THE accepted standard underground conduit for 42 years has been Orangeburg because of its LOW INSTALLATION COST, ACCURACY OF ALIGNMENT, TIGHTNESS OF JOINTS, MAXIMUM CABLE PROTECTION

The Fibre Conduit Company • ORANGEBURG, N. Y.

SALES AGENTS

GENERAL ELECTRIC SUPPLY CORP. • GRAYBAR ELECTRIC COMPANY



Induced-draft fan and pulverizer sequenced after forced-draft fan

Dual-Speed Fan Motors Interlocked

By A. P. SCHNYDER
Electrical Engineer
with George F. Hardy, Consulting Engineer, New York

Induced-draft fans should be started before the forced-draft fans and pulverizers are started. The interlocks for this function, as shown in the diagram, are as laid out for a paper mill in conjunction with the installation of three 1,100-horsepower, high-pressure boiler units.

The induced- and forced-draft fans each have a dual motor drive for low- and high-speed operation. The undervoltage relay which interlocks the low-speed motor against the high-speed one has an adjustable time-delay feature which is set to allow the high-speed motor to drop its speed to within the lower speed range upon transferring from "fast" to "slow" before the slow motor is connected.

The main feature of this wiring is this interlock of the forced-draft fan and coal pulverizer-mill motors against the induced-draft fan. All control push buttons were located at the combustion control instrument board for convenience in manipulation.

•

Amber-Like Resin

What may prove most useful in the electrical industries is a new material launched by Imperial Chemical Industries at the British Industries Fair, which has just opened in London.

Known as "Leukon," this material is a transparent synthetic resin which is capable of treatment by either compression or injection molding, and it is being displayed in granular form. The material has the important characteristics of low weight, good mechanical strength and insolubility in water, alcohol and aqueous media. As an insulator it is stated to be nearly as good as amber, while the thermal conductivity is also very low. In the electrical industries it should be eminently suitable for the production of bobbins, coil formers and other components where high dielectric qualities are required.

•

Sign Fronts Improve Definition

Neon tubes placed behind translucent, diffusing letter fronts in the outdoor display signs on the marquee of the Folies Bergères in New York have produced a distinct and sharply outlined sign. Light from the neon tubes is uniformly diffused over the area of each front, giving the effect of a solid letter, as contrasted with letters outlined with neon tubes alone, which depend upon reflected light to fill out the letter.

This type of letter front is easily cleaned, is neither brittle nor inflammable and can cause no hazard from breakage or fire. The material used is a new phenolic product called "Catalin," of American Catalin Corporation.

•

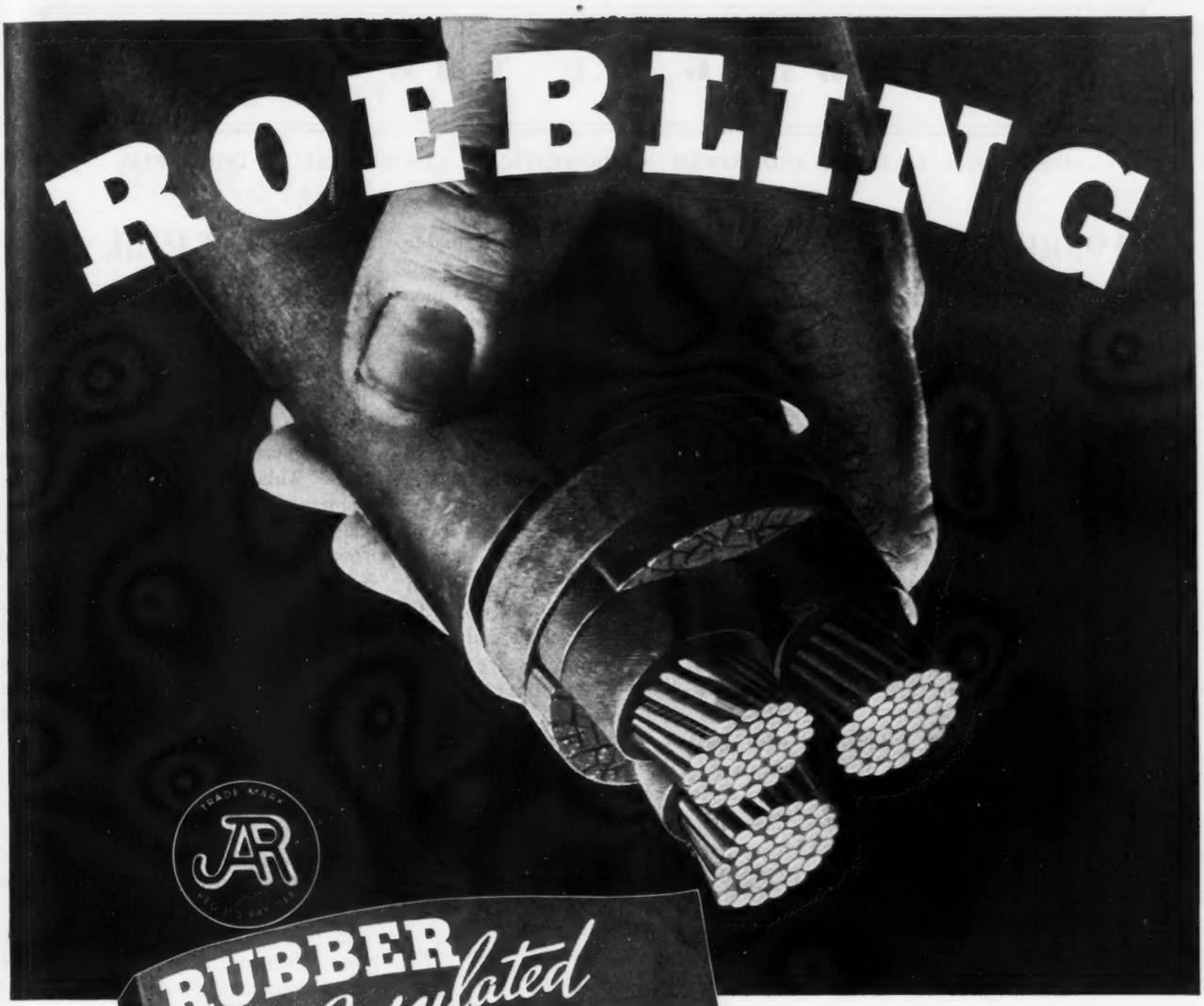
Light Filters Intercept Radiation

Use of high-intensity lighting equipment for operating rooms, show windows, motion-picture production, etc., introduces several problems. They include disposal of the sensible heat resulting from operation of the lamp and infra-red radiation; protection of objects and materials from fading, and avoiding discomfort among people working under the high-intensity light. To a great extent the problem is one of disposing of the heat produced.

Radiation-intercepting glass is being used to filter out the heat rays and ultra-violet radiation, without decreasing the amount of light passing through it. The heat thus intercepted is confined to the upper strata of the room and can be discharged outdoors through ducts or recirculated to warm the building in winter.

Reduction in air-conditioning requirements has been accomplished by the use of "calorific filter" glass, reported Norman Macbeth, Daylight Lighting Company, recently in a demonstration before the New York section of the Illuminating Engineering Society. As much as 100,000 B.t.u. per hour was thus diverted in a showroom, he declared. In another case, where the illumination intensity on the working plane reached 250 ft.-candles, use of "calorific" glass so minimized the heat radiation that it could not be felt, it was claimed. Intensities as high as 1,000 to 1,500 ft.-candles are entirely possible with no great increase in ambient temperature at the working level, declared Mr. Macbeth.

Outdoor display sign using diffusion letter fronts



For power transmission, railway signaling, building wiring, and many other purposes, Roebling Rubber Insulated Wire and Cable are available.

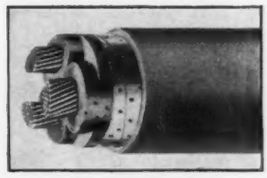
Plain Rubber 60% Sheath Power Cable. "SAFECOTE" Rubber-insulated and Braided Wires and Cables: Code, Intermediate, 30% and 40% Performance, 35% and 40% Performite. 40% and 60% Sheath Flexible Cords. Parkway, Service, Mining, Welding, and Control Cables; Tree Wire.

These will give you a fair idea of the completeness of the Roebling Line. They are made in a wide range of sizes and voltages. Armors:—steel, zinc, or bronze tape, or round steel wire.

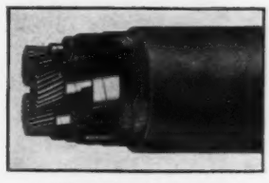
MANY OTHER TYPES

Power Cables: Paper; Cambric; Rubber » Station Cables » Slow Burning Wires and Cables » Weatherproof Wires and Cables » Submarine Cables » Portable Cords » Fixture Wire » Magnet Wire » And a wide variety of other wires and cables.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON, N. J. *Branches in Principal Cities*



Roebling Paper Insulated Cable.



Roebling Varnished Cambric Insulated Cable.

ONLY A FINE PRODUCT MAY BEAR THE NAME ROEBLING

BUILDING UP THE LOAD

APPLIANCES, LIGHTING AND POWER • DOMESTIC • COMMERCIAL • INDUSTRIAL

A $19,000,000 Selling Program

Geared to co-ordinate the efforts of all agencies in the gas and electric industries, a 1935 sales program is under way through the sponsorship of the Pacific Gas & Electric Company. An attractive booklet has been published giving all details of the co-operative plan. The company will spend $1,750,000 in sales promotion for all sales outlets. An inducement offer of a 50 per cent reduction in cost of extra use of electric energy by domestic and commercial lighting customers is an important feature of the program.

As pointed out by Mr. Hockenbeamer, "the financial stability of the utilities and their future progress depend upon increased loading of existing facilities and consignment reduction of unit costs." As an aid to manufacturers, jobbers and dealers, P.G.& E. has made a market analysis of the territory and has tabulated the basic incomes that sustain the area. An appliance survey gives valuable data on where and what to sell.

A company sales force of 430 men is organized into twelve divisions to give specialized effort to each of four classifications of business—domestic, commercial, industrial and agricultural. Specially trained dealer contact men are included and the company's sales plan is essentially creative. The principal features of the plan are: (1) Promotion of domestic consumption and appliance use; (2) promotion of commercial, industrial and agricultural consumption and use; (3) promotion of street lighting and other power use; (4) comprehensive advertising; (5) use of appliance survey and market analysis; (6) co-operation with dealers, jobbers and manufacturers and the gas and electric appliance societies. The 50 per cent reduction offer for extra use is a primary incentive to business development.

Special campaigns will be instituted each month on particular appliances. An endeavor is made to mobilize the entire industry and the results to date exceed budget expectations.

Central Hudson Gas & Electric Corporation has designed a special open-body truck for use by rural representatives. With a range or refrigerator on board, they drive up to the prospect's house and show it to her. The portable stairs and guard rail make it safe and convenient.

8-Mill Off-Peak Water Heating Sells

Since the inauguration of an 8-mill off-peak water heating rate last April the Georgia Power Company added a total of 1,800 water heaters in a nine-month period ended December 31, 1934. This rate is applicable only to residential or commercial storage water heaters to which energy is supplied through a special circuit sealed in conduit and to which no other appliances may be connected. Service to the heating element or elements will be limited to operating periods aggregating not more than fifteen hours per day. At the present time the operating periods are:

Service on at 8 p.m. —— Off at 7:30 a.m.
Service on at 1 p.m. —— Off at 4:30 a.m.

The company retains the right to change the operating periods so that they will not coincide with the peak-load periods on the distribution system. When unrestricted service to the top element is desired, it may be connected, at the customer's expense, to the regular house meter with the time switch control on the bottom element only.

Of the 1,800 water heaters added to the lines, 1,359 have been connected so as to be billed on the new off-peak water-heating rate. The other 341 water heaters have been connected to the regular house meters to use up the free kilowatt-hours available under the residential inducement rate. The major portion of the water heaters sold the last nine months have been small 30-gal. heaters. These heaters are readily adapted to the small family and will supply a sufficient amount of hot water on the off-peak rate for the average needs.

Figures compiled for the nine periods show that the average monthly consumption per heater is 277 kw.-hr. and that the average bill per month per meter is $2.30. This gives an average cost of 0.83 cent per kilowatt-hour, which is slightly higher than 8 mills. This discrepancy is due to some

The First Big Review of New and Improved Products in 3 Years

E. E. I. Convention Issue of ELECTRICAL WORLD MAY 25th

Copies will be distributed at the Edison Electric Institute Convention at Atlantic City in addition to the regular circulation list comprising key utility men, industrial electrical engineers, electrical manufacturers, consulting engineers, railway, government and telephone engineers—a comprehensive coverage of electrical buying.

Phone, write or wire NOW for complete details of the 7 reasons why May 25th represents a most timely sales promotion opportunity.

ELECTRICAL WORLD—330 West 42nd St., New York, N. Y.

A Permanent Exhibit on Paper

40 pages of progress—a complete resume of outstanding developments of new and improved products—showing the new features, their application and economic or operating advantages—embracing all developments from production to utilization.

Act NOW—Last Forms Close May 15th

Taking Appliances to the Rural Buyer

Here is the "Wife-Saving" kitchen coach of the Arkansas Power & Light Company, which has already demonstrated its effectiveness in the company's recently inaugurated plan for rural electrification extension in the state. In the picture are Mrs. John McCain, home economist, and W. G. Givens and Max Sudduth of the sales department of the company.

customer using less kilowatt-hours than the minimum monthly charge of $1 allows.

•

Prizes Stimulate Load Building

Central Maine Power Company has summarized results of load building during 1934, adding an average of 26 kw.-hr. for each of the company's 64,000 customers. The campaign centered around cash prizes of $100 for each town representative who could increase his kilowatt-hour use 50 or better. For each additional kilowatt-hour over 50 he received a bonus of $1. In addition to the town representatives, the campaign was further consolidated into districts, with each district superintendent who could get his group of towns up 50 kw.-hr. or better likewise receiving $100—with the bonus of $1 additional for each extra kilowatt-hour over 50. The districts were consolidated into divisions, with each division sales manager likewise eligible for the same cash awards.

The winning town representative increased his kilowatt-hour standing 104 per customer for a total of 706 kw.-hr. for the year. Seven other representatives added 50 or better, with one district superintendent eligible, dividing more than $1,000 in cash prizes.

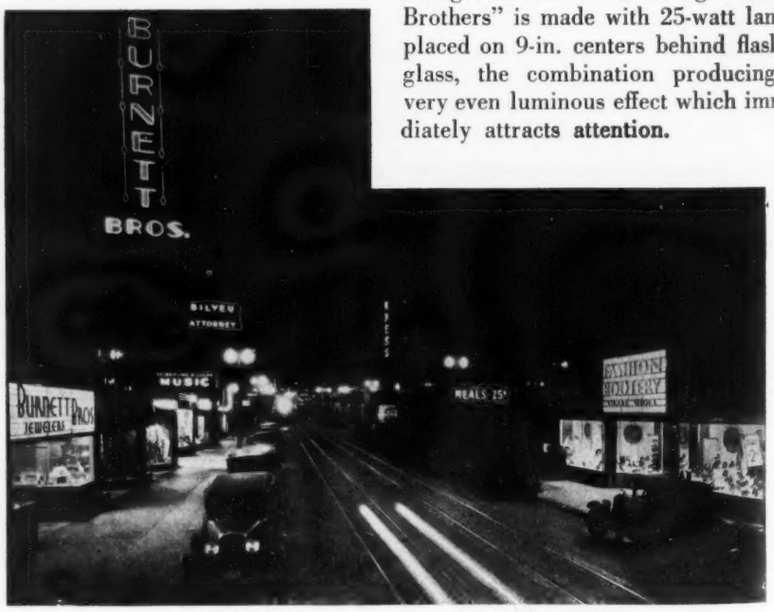
The campaign greatly stimulated the sale of ranges and refrigerators and the company believes this activity largely responsible for its sale of more than 1,600 ranges during the year, the largest number ever sold in a single year. Refrigerator sales also reached a new high for the year, going over the 1,000 mark.

Certified Lighting

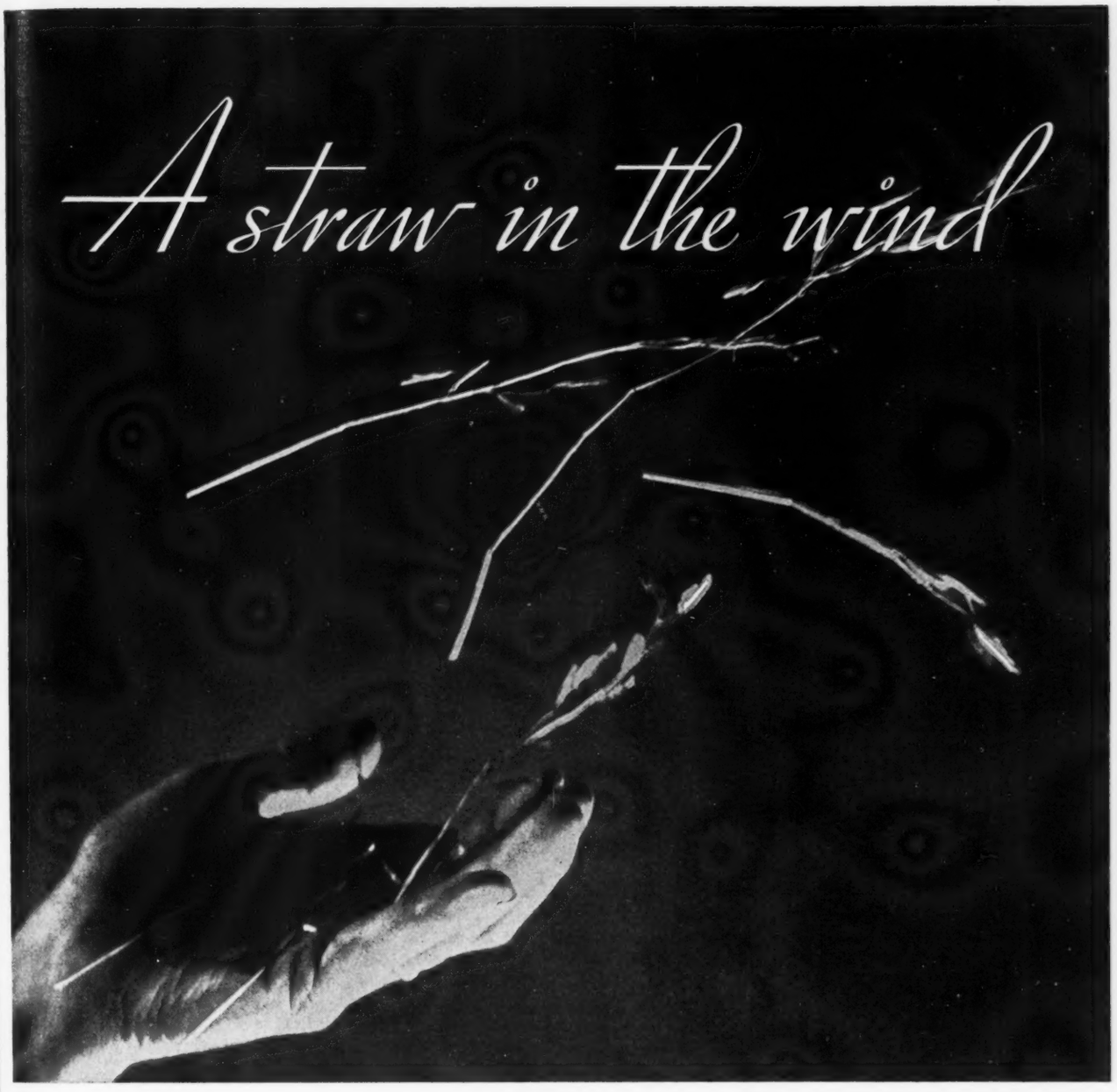
In Portland, Ore., the Northwestern Electric Company's sales department has developed a load-building idea that helps sell adequate commercial lighting. The illuminating engineers of that company prepared standards for various types of commercial illumination. Any establishment which revises its lighting installation to conform to the levels of illumination prescribed by these standards is presented with an attractive certificate suitable for a prominent display within the store. The certificate advises the customer that that particular establishment has installed correct lighting, thus bringing to the attention of those who enter the store the real reason why it appears so attractive.

The accompanying illustration shows the contrast between certified lighting as exemplified by the stores of Burnett Brothers on the left and the Fashion Bootery on the right and the inadequate window lighting of other stores along the street. The striking way in which spectacular lighting makes one store stand out from its neighbors is an advantage which can be capitalized upon by alert merchandisers.

In Burnett Brothers' windows the intensity is 500 foot-candles, obtained by using 200-watt lamps on 12-in. centers mounted in flush-type silver mirror reflectors. In the windows of the Fashion Bootery the intensity is 300 foot-candles. Both of these installations embody luminous lighting, utilizing flashed glass behind which are placed electric lamps. The illuminated background for the lettering "Burnett Brothers" is made with 25-watt lamps placed on 9-in. centers behind flashed glass, the combination producing a very even luminous effect which immediately attracts attention.



Certified lighting makes the stores of Burnett Brothers and Fashion Bootery dominate the merchandising displays in this Portland, Ore., block



Reports from major dealers in various parts of the country indicate that they are selling more than twice as many Frigidaires this year as they sold in the same period of 1934. Here is a straw in the wind that clearly indicates the direction of public preference—and the direction in which you should turn for real refrigeration profits in 1935.

Frigidaire '35

THE GENERAL MOTORS REFRIGERATOR

MEN OF THE INDUSTRY

A. W. Conover New President of Colorado Utility

A. W. Conover, vice-president and general manager of the Oklahoma Utilities Company, Bristow, for the past four years, has been made president of the Colorado Central Power Company with headquarters in Denver. The Colorado

A. W. Conover

Central Power Company is a subsidiary of the Electric Public Service Company of Philadelphia, which also controls the Oklahoma Utilities Company.

Mr. Conover has been an active worker in the Oklahoma Utilities Association during his residence in Oklahoma and since 1933 has been a member of the Electrical Code Committee of NRA, representing the small electric utilities. His removal from the state interrupts his service as president of the Bristow Chamber of Commerce. A native of New Jersey, Mr. Conover was identified with utility properties in the East and South before going to Oklahoma in 1931. He will be succeeded on the Oklahoma properties by R. W. Booze, general manager of the Colorado properties.

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▶ P. R. CHAMBERS, for six years district manager of the New York State Electric & Gas Corporation, has been appointed group manager of the corporation's western New York group of properties with headquarters at Lancaster. Mr. Chambers will succeed O. TITUS, who assumes the management of the Binghamton group. D. PRICE of Oneonta, N. Y., will succeed Mr. Chambers.

▶ LAWRENCE W. WALLACE, vice-president of the W. S. Lee Engineering Corporation, Washington, D. C., has been named director of equipment research by the Research Advisory Board of the Association of American Railroads. His work as secretary of the American Engineering Council gave him an excellent training in the promotion and administration of large projects in engineering research. In 1921 Mr. Wallace became secretary of the American Engineering Council, then known as the Federated American Engineering Societies. He remained in this capacity until 1934, when he became vice-president of the W. S. Lee Engineering Corporation, in charge of its Washington office.

▶ T. O. RUSSELL, consulting engineer of Eugene, Ore., has been appointed chief engineer of the Public Utilities Commission of Oregon by the new commissioner, Frank C. McCulloch. Mr. Russell is succeeding Claude R. Lester, who has been retained by the commission for special work in connection with litigation in the Pacific Telephone & Telegraph Company and Northwestern Electric Company rate cases, still pending.

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F. S. Gillespie Assumes New Executive Duties

F. S. Gillespie has been appointed manager of industrial relations of the Northern Indiana Public Service Company, Hammond, Ind., to succeed James M. Brodbeck, resigned. Before his promotion to his present position Mr. Gillespie had charge of disbursements and stores accounting in the general offices of the company. He has been with the Northern Indiana Public Service Company since 1924. Prior to that time he

F. S. Gillespie

was employed in the general office of the Central Illinois Public Service Company in Springfield and left that utility to go to Hammond as supervisor of the payroll department of the Northern Indiana Public Service Company. Mr. Gillespie is a native of New Mexico and a graduate of the University of Illinois.

A. C. Colby Named President of Indiana Utilities

A. C. Colby has been named president of the Gary Electric & Gas Company and its operating subsidiary, the Gary Heat, Light & Water Company, Gary, Ind. In addition to occupying the presidency of the Gary Heat, Light & Water

A. C. Colby

Company, Mr. Colby is also general manager of that company, George N. Rooker, formerly vice-president and general manager, having resigned.

Mr. Colby has been in the transportation branch of the utility business since 1900. His early experience was obtained with the old Union Railroad Company, Providence, R. I.; the Chicago, South Bend & Northern Indiana Railway and the Birmingham Railway, Light & Power Company. Subsequent connections followed with the Birmingham, Ensley & Bessemer Railway Company, the Berkshire Street Railway Company, Pittsfield, Mass., and the Connecticut Company, a subsidiary of the New York, New Haven & Hartford Railway. More recently Mr. Colby spent eleven years with the municipal street railway company in Detroit. While there he established a record of economy and efficiency that caused him to be chosen in 1931 to take charge of the Chicago & Calumet District Transit Company and the Gary Railways.

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▶ WILLIAM F. RIPPE, chief engineer of the Kearny generating station of the Public Service Electric & Gas Company, has been appointed planning and installation engineer to succeed Walker L. Cisler, recently named general superintendent of generation (ELECTRICAL WORLD, March 30, page 130). DONALD C. LUCE, load schedule engineer, will succeed Mr. Rippe as chief engineer at

GLASS *was in use 6000 years ago. In colors, it was first used in cathedral windows around 400 A. D., but plain window glass was not used till about 1600.*

GLASS is one of the oldest and most useful of man-made materials. It represents a basic discovery, without which civilized man would be sorely handicapped. . . . Another basic discovery was that which gave electric heat to home and industry. This was the development, by A. L. Marsh in 1906, of the heating-element alloy of chromium and nickel, called Chromel. Before this, no heating-element lasted long enough to permit applied electric heat to be practical. + + Thus Chromel became the seed from which has grown the entire heating device industry out of which has come one of your year-round markets. And you know, too, that the standard devices are virtually trouble-free. "Burn-outs" come with such infrequency as to remind you how extremely durable the Chromel elements have been. You may safely put your trust in devices that are Chromel equipped. Hoskins Mfg. Co., Detroit, Mich.

H O S K I N S

CHROMEL

THE *wire* THAT MADE ELECTRIC HEAT POSSIBLE

Kearny. PHILIP H. HARTUNG, who has been fuel engineer, will succeed Mr. Luce as load schedule engineer. JAMES A. ROSE, formerly test engineer at the Essex generating station, succeeded Mr. Hartung as fuel engineer April 1.

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J. W. Cowles to Retire

Joseph W. Cowles, for the past 32 years superintendent of the installations department of the Edison Electric Illuminating Company of Boston, will retire from active service on May 1. Mr. Cowles is known throughout the power

J. W. Cowles

industry as a leading code authority and has served for many years on code committees of the National Electric Light Association, Association of Edison Illuminating Companies and National Fire Prevention Association.

He is a native of Norfolk, Conn., and after graduating from Cornell University in 1890 he entered the employ of the Thomson-Houston Electric Company at Lynn, Mass., later being connected with the introduction of the inclosed arc lamp for the Marks Ayer Company of New York City, until joining the Boston Electric Light Company's organization 40 years ago. His early utility work was devoted to underground construction, after which he developed a meter and general testing department. Upon the consolidation with the Edison company in 1901 Mr. Cowles became assistant head of the standardizing and testing laboratory, later being engaged in statistical and distribution engineering work.

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▶ GEORGE H. BLAKE has been named to the executive committee of the Public Service Corporation of New Jersey in place of George H. Howard, resigned. OGDEN H. HAMMOND has been elected a director of the corporation in place of Mr. Howard.

▶ FRANK A. MERRICK, president of the Westinghouse Electric & Manufacturing Company, left San Francisco on April 20 for a tour of the Orient. Mr. Merrick will spend more time in Japan than in any other section. He is planning to make a three-week visit there, then proceeding to Shanghai, Hong Kong and Manila.

▶ DR. ALBERT EINSTEIN and SIR JOHN AMBROSE FLEMING have been selected by the Franklin Institute as this year's recipients of the Franklin Medal. Dr. Howard McClenahan, director of the institute, stated that the medals would be conferred upon the physicists at the annual Medal Day exercises on May 15. Dr. Einstein, now a member of the staff of the Institute for Advanced Study at Princeton, will deliver the main address at the Medal Day meeting. Sir John, 85-year-old electrical engineer, whose invention of the Fleming thermionic valve was one of the fundamental achievements making possible the present-day long-distance wireless communication, will not come here from his home in Devon, England, to receive the award. Franklin Institute officials expressed the hope that the British Ambassador would be able to receive the award in behalf of the recipient.

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L. D. Gibbs Granted Leave by Boston Edison

Louis D. Gibbs, superindendent of the advertising department and assistant head of the public relations bureau of the Edison Electric Illuminating Company of Boston, has been granted a leave of absence and will sever his connection with the company in August after nearly 30 years of service. Mr. Gibbs is widely known in utility circles. A native of St. Johns, Mich., and a graduate of Oberlin College, Mr. Gibbs engaged in newspaper work before he joined the sales department of the Boston company in 1906. In 1910 he was made superintendent of advertising and was promoted to the post of assistant head of the public relations bureau in 1924 upon its organization. Mr. Gibbs is a past-president of the New England division of the N.E.L.A. and a former vice-president of that organization. He has served two terms as president of the Advertising Club of Boston.

L. D. Gibbs

OBITUARY

Frank B. Steele

Frank B. Steele, formerly vice-president and general manager of the Utica Gas & Electric Company, died at St. Luke's Hospital in Utica, N. Y., April 17, in his fifty-first year. Mr. Steele had resigned his executive position with the Utica utility in 1929 and at the time of his death was deputy city engineer of Utica, but was on leave so as to serve under the Temporary Emergency Relief Administration as assistant to the commissioner. Before going to Utica in 1918 he had had a wide experience in the public utility field in various sections of the country. Mr. Steele was a member of the American Institute of Electrical Engineers and was active in the Empire State Gas and Electric Association, the American Gas Association and in the old National Electric Light Association.

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▶ HARRY R. BROWN, president of the Brown Battery & Electric Company, Denver, Colo., died December 5, of a heart attack, in his sixty-fifth year.

▶ HARRY R. KEMPE, famous British electrical engineer, died at Brockham, England, recently at the age of 83. Mr. Kempe was well known to engineers throughout the profession for his Engineers' Year Book, which he had brought out every year since 1894.

▶ SIR EDWARD SHARPEY-SCHAFER, inventor of the Schafer method of artificial respiration, died March 30 in his Northumberland (England) home in his eighty-sixth year. It was in 1903 that Sir Edward devised the plan of resuscitation, also known as the "prone-pressure" method, that carried his name around the world. It has resulted in the saving of untold thousands of lives, being used not only in drowning accidents but also for persons asphyxiated by smoke, gas, fumes or surgical anesthesia, whose normal respiratory functions have been temporarily arrested. In 1924 the National Electric Light Association, which some ten years earlier had indorsed the plan, interested the United States Public Health Service in arranging a conference in connection with standardizing the technique in the prone-pressure method, and as a result it was approved by several government agencies as well as private associations. An outstanding figure in the fields of histology and physiology, Sir Edward was the recipient of several awards for his scientific achievements.

▶ ARTHUR I. MANN, an executive of the Consolidated Wire and Associated Corporations, Chicago, died March 10. He was the son of the late Samuel Mann,

one of the pioneers in the wire industry. Under the able tutelage of his father, Mr. Mann obtained an extensive knowledge of the wire business and later joined Consolidated Wire in an official capacity, remaining with the organization until his death.

▶ WILLIAM C. ADAMS, consulting engineer, Northern Electric Company, Ltd., Montreal, Que., died January 7 in his fifty-sixth year. He had been identified with the Northern Electric Company since 1919. Mr. Adams was a member of the American Institute of Electrical Engineers, the Engineering Institute of Canada, and represented the Canadian Manufacturers Association on the main committee of the Canadian Engineering Standards Association and his company in the American Society for Testing Materials.

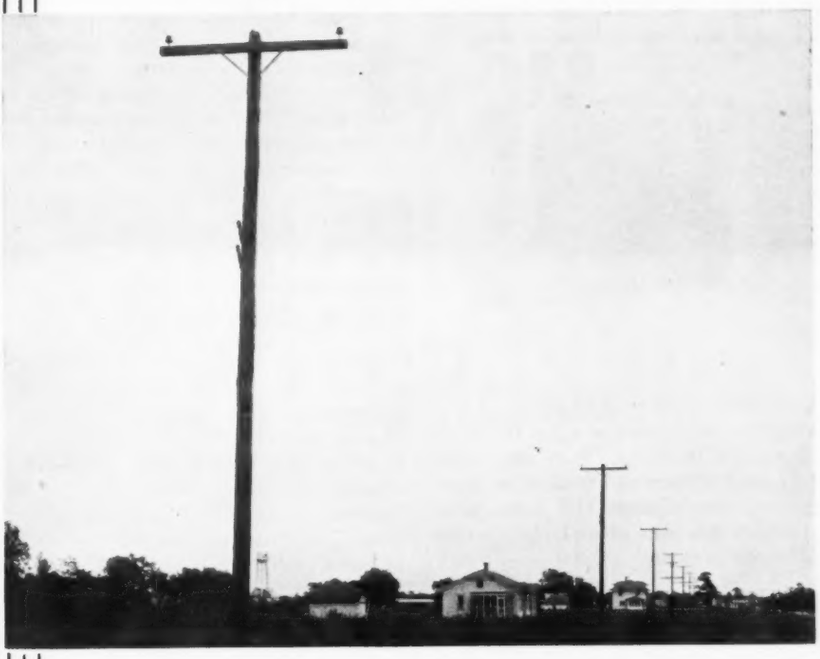
▶ MARSDEN J. PERRY, retired capitalist and public utility promoter prominent in Rhode Island affairs prior to the World War, died in New York April 15, after many years of poor health. He acquired control of the Fall River (Mass.) Electric Light Company in 1882 and later became president of the Narragansett Electric Lighting Company of Providence. At the time of his death he was vice-president of the Nicholson File Company, Providence, and a director of the General Electric Company. In 1890-91 he was president of the National Electric Light Association.

▶ RUDOLPH M. HUNTER, consulting engineer, inventor and patent attorney, died at his home in Philadelphia March 19, after an illness of two weeks. Mr. Hunter sold many patents to the Thomson-Houston Electric Company, was retained by it in 1889 as electrical engineer and patent counsel and remained in those capacities with the General Electric Company for 22 years. Licenses for more than 300 of his inventions were granted to General Electric and the Westinghouse Electric & Manufacturing Company. He was 78 years of age.

▶ EDGAR F. PRICE, formerly vice-president of the Union Carbide & Carbon Company, died at Port Chester, N. Y., April 15, in his sixty-third year. After a short period with the Westinghouse interests Mr. Price joined the Union Carbide Company and later became president of the Electro-Metallurgical Company. When the Union Carbide & Carbon Company was formed to co-ordinate the work of several organizations engaged in closely related fields Mr. Price became vice-president, a position he held until his retirement in 1925.

▶ E. A. CERF, JR., assistant engineer with the Brooklyn Edison Company, died suddenly, April 9, in Welland, Ont., Canada, from injuries sustained in an automobile accident. Mr. Cerf was 30 years of age.

Proved Pole Values for Tomorrow's Expansion . . .



WHEN the utility industry resumes its temporarily delayed expansion, it will need sound facilities upon which to build. AmCreCo poles in today's distribution lines will still be sound and strong when called upon to carry additional loads under the expansion of tomorrow.

AmCreCo poles provide this proved value without any penalty in today's costs. By careful selection and full utilization of the advantages offered, first cost of these poles can be kept low, and their annual charges run considerably below short-lived poles.

These southern yellow pine poles are made from the strongest of pole woods, and the full length pressure creosote treatment given every AmCreCo pole retains that strength throughout its serviceable life.

Why AmCreCo Poles Have Maximum Quality

1. Select southern yellow Pine.
2. Incipient decay avoided.
3. Framing before treatment.
4. Preservative of known value.
5. Adequate single treatment.
6. Treatment accurately timed to proper seasoning.
7. Full length pressure treated.
8. Unequalled facilities and personnel of the leading producer.

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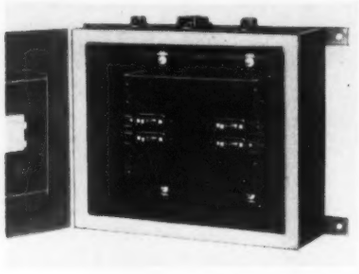
GEORGIA CREOSOTING COMPANY INCORPORATED
LOUISVILLE — KENTUCKY

NEW EQUIPMENT

Dust-Tight Panelboard

Benjamin Electric Manufacturing Company, Des Plaines, Ill., has just placed on the market a "Nofuze" circuit-breaker panel with a dust-tight-inclosing cabinet. This panel has been designed to meet the



Benjamin Electric

requirements of the Underwriters' Laboratories for installation in Class II, Group G hazardous locations. It is more commonly used in flour and feed mills, grain elevators, starch, sugar and cocoa mills and similar locations where large amounts of dust are present.

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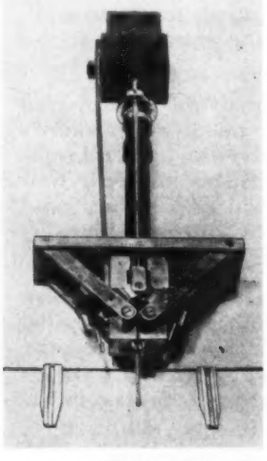
Full Automatic Arc Welding With Heavily Coated Electrodes

Full automatic arc welding with heavily coated electrodes is now possible by the use of woven welding wire and electrode contactor apparatus manufac-



Welding Wire Co.

tured by the Welding Wire Company, New Britain, Conn., it is claimed. Welding speeds as high as 15½ in. per minute with ⅜-in. stock have been obtained, it was stated.

The electrode contactor is of the toggling, free passage type using tangential grip and plunger type straightener. The take-off reel consists of a tapered barrel with a demountable rim, having a sliding contactor which makes use of the electrode coil as a high resistance to balance the variable resistance of the arc, eliminating undesirable arc stray.

Woven welding wire consists of a wire mesh filled with flux, which keys the flux to the electrode and allows passage of high currents to the core. This type electrode is stocked in sizes $\frac{1}{8}$, $\frac{5}{32}$, $\frac{3}{16}$, $\frac{1}{4}$ and $\frac{5}{16}$ in. diameter.

•

Heavy-Duty Automatic A.C. Network Protector

Heavy-duty automatic a.c. network protector for subway and vault service, embodying design features of importance to safe and reliable operation and long life, has been announced by the General Electric Company. Each phase of the breaker is completely isolated by barriers. A simplified closing mechanism is used, which eliminates high-speed, high-inertia moving parts. The relays are of an induction-cylinder type of light weight and small size, which operate at high speeds with improved operating characteristics and high torque. All sub-assemblies are interchangeable, each unit's sub-assembly being easily removed and replaced. Relays are bracket mounted.

Simple, compact design gives the new type MG-8 and MG-9 network protectors reduced size and permits their installation in smaller vaults. The design of these new protectors also provides flexibility in the placement of the unit in underground vaults and makes all parts readily accessible for inspection and maintenance.

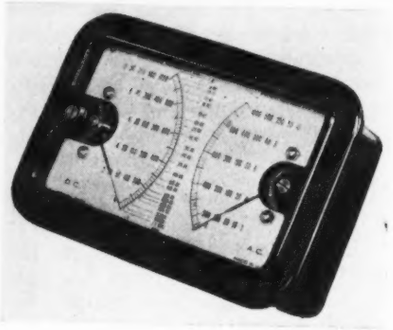
Type MG-8 submersible network protector is available in 800, 1,200 and 1,500 amp. ratings for 120/208 Y volts, 60 cycles, three phase. Type MG-9 non-submersible network protector is available in the same ratings and in addition may be obtained for 2,000 amp. Interrupting rating of all protectors is 20,000 amp. at rated voltage.

•

FORGED CLAMP, WIRE AND CABLE LUGS having higher strength and conductivity than cast lugs have been announced by the Burndy Engineering Company, New York. These lugs are easily installed by inserting the wire or cable in the serrated jaws and tightening a nut.

Volt-Ohm-Milliammeter

Triplett Electrical Instrument Company, Bluffton, Ohio, announces No. 1200 volt-ohm-milliammeter now available in kit form. It is the same as the



Triplett Instrument Co.

master model, except that it does not have the panel, the adjustable feature on the meter, the batteries or case, but does have index marking. It is furnished complete with all shunts, resistors, condensers, coils, drilling template, blueprints and instructions.

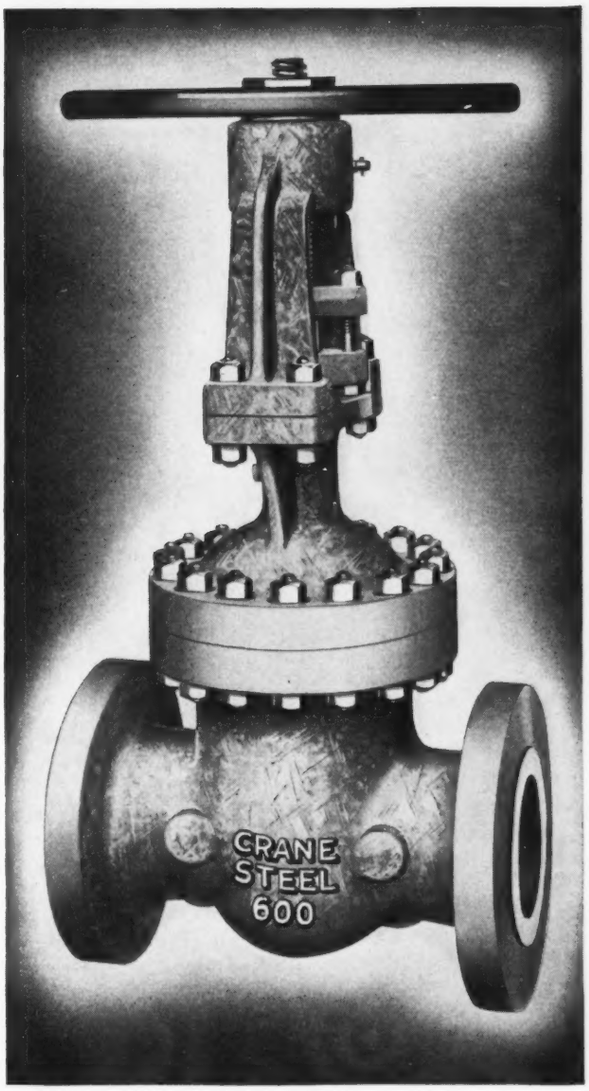
•

Switch Inclosures for Special Locations

A new line of switch inclosures for special locations has been announced by Allen-Bradley Company, Milwaukee, Wis. Type G, explosion-proof inclosure, for hazardous gas locations; type B, water-

Allen Bradley

tight, weatherproof inclosure, and type D, dust-tight inclosure, for installations where dust is encountered, are now available for Bulletin 709 switches of sizes 2 and 3. Switches available for these inclosures will take care of all polyphase motor requirements up to 15 hp., 110



A START FROM HIGHER GROUND

One of the new Crane Series 600 W. S. P. alloy cast steel wedge gate valves, rated for 600 pounds steam working pressure at 900° F.

Remember the old adage: "You always get up a little ahead of where you fell down?"

Poised for a fresh start, the electrical industry finds itself on higher ground than before. New processes, new materials, new efficiencies are everywhere.

Crane Co., in its own laboratories, has been pushing to new levels the stamina and efficiencies of the equipment it makes for generating plants. Not a little of the advance to be made in the industry will be due in some measure to these efforts, which include the development of a new line of valves, fittings and fabricated piping of *steel* . . . for higher pressures, higher temperatures, higher efficiencies.

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volts; 30 hp., 220 volts, and 50 hp., 440-550 volts, as well as single-phase motors. Type D, dust-tight inclosure shown, is made of cast iron. The surface between the cover and base is machined, making a seal without the use of gaskets. The top and bottom of the base are tapped for threading in conduit.

•

Optical Pyrometer

One-piece, light-weight, portable, optical pyrometers with a temperature range from 1,500 to 3,000 deg. F. have been recently marketed by the Burell Technical Supply Company, Pittsburgh, Pa. Direct readings of temperature are made by focusing the telescope eye-piece on the standard pyrometer lamp in the instrument and adjusting the rheostat until the brightness of the lamp filament equals that of the hot body being measured.

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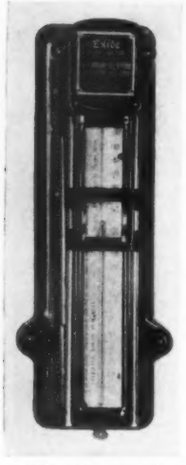
Average Voltage Found by Float Meter



Electric Storage Battery

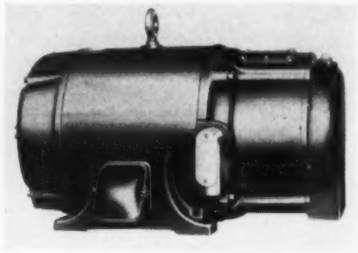
"Exide Float Meter," a recent development of the Electric Storage Battery Company, Philadelphia, is a device for determining the average voltage of a battery or other direct-current device over a period of time. It operates on the principle of the electrolytic ampere-hour meter with an accuracy of 0.25 per cent and draws a current of from 0.004 to 0.010 amp. A particular application of the meter is in connection with "floated" batteries, where it is desired to maintain a certain average voltage. The meter can be used to determine either the average voltage or to assist the operator in maintaining the desired average voltage from day to day, tthrough the use of a special calendar scale.

•

A RANGE MULTIPLIER FOR LIGHT METERS, consisting of a light-absorbing screen that clamps over the exposed surface of the photoelectric cell, has been announced by the Westinghouse Electric & Manufacturing Company. The screen absorbs 90 per cent of the normal light and transmits the other 10 per cent without producing any change in color or wavelength of the light transmitted, thus permitting the measurement of high light intensities.

Splash-Proof Motor Permits Washdown

Century Electric Company, St. Louis, Mo., has announced a new line of splash-proof, slip-ring, polyphase motors. Baffled openings in the end bracket admit cooling air and exclude splashing water. The end bracket opposite the drive is



Century Electric

constructed with a covered handhole for convenient inspection and a removable section which protects the end assembly of the motor.

•

Unit Type Ventilating Fans

New type unit fans which can be used singly or assembled in groups for space, attic or window ventilation have been announced by the Reed Unit-Fans Inc., New Orleans. Light-weight, low investment and operating costs and efficient air volume control are among the advantages claimed. Each unit is equipped with self-contained detachable louvers and fully inclosed 110-volt, 60-cycle motors, capable of delivering 1,700 cu.ft. per minute of free air.

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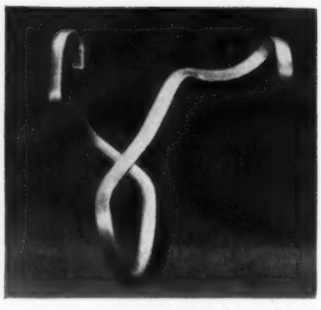
Corrosion-Resisting Cable Rings

Corrosion-resisting-steel cable rings for supporting lead-clad telephone and telegraph cables where severe corrosion conditions exist are announced by



Bethlehem Steel

the Chance Company, Centralia, Mo. These rings far outlast rings made of carbon spring wire and are especially suitable for use in industrial atmospheres, through tunnnels and other severe exposures, it is stated. The wire used is drawn from "Bethadur" No. 2, corrosion-resisting steel, made by the Bethlehem Steel Company.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

General Electric has announced a 34-page bulletin dealing with luminous tube transformers. Operation, construction, rating tables, specifications, dimensions, power-factor correction curves and recommendations for application are given.

General Plate Company, 48 Forest Street, Attleboro, Mass., has issued a new "handbooklet" on the uses of Truflex thermostatic bimetal. Charts for rapid calculation of applications of this as well as of composite-metal contact buttons are included.

Report on A.C. Network Operation (1932–33) of Edison Electric Institute, 420 Lexington Avenue, New York (Publication B-12) is available to non-members at $1. Its 20 pages continue the previous report of operating and engineering characteristics of transformers, primaries and secondaries. Publication B-11 is a 1933 continuation of the 1932 Cable Operation report and is available to non-members at $1.50 (33 pages of tabulated experience with power cables).

Announcement has been made of the 1934 edition of the N.E.M.A. Motor and Generator Standards. The manufacture, test and performance of a.c. and d.c. motors, generators and motor-generator sets are covered in the issue. Copies may be obtained for $2 from the National Electrical Manufacturers Association, 155 E. 44th Street, New York.

Properties, uses and methods of application of Bakelite heat hardenable varnish, enamel, lacquer and cement are in a 39-page bulletin published by the Bakelite Corporation, River Road, Bound Brook, N. J.

Bulletin HM-1, covering construction and operation of its line of convertible P&H motors, has been announced by the Harnischfeger Corporation, West National Avenue, Milwaukee, Wis.

Assembly features, specifications and a detailed description of box-type electric furnaces are in a bulletin, HD-135, announced by Hevi-Duty Company, Milwaukee, Wis.

Design features, installation and operation diagrams, and flow charts of thermo-hydraulic feedwater regulating systems, together with descriptions, assembly drawings and engineering data on tight-seating, sleeve and excess pressure regulating valves are in bulletin No. 83 of the Bailey Meter Company, Cleveland, Ohio.

Essential characteristics of "Velox" steam generators and engineering data on existing installations are in a reference list recently issued by Brown Boveri & Company, 19 Rector Street, New York.

A series of ten bulletins issued by General Refractories Company, 106 South Sixteenth Street, Philadelphia, cover various refractories, their properties, temperature ranges and fields of application.

A pamphlet covering application, design, construction, rating and giving wiring diagrams of its auto-transformers has been announced by Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Jefferson Electric Company, Bellwood, Ill., has prepared a vest pocket chart to show lengths of various sized neon and mercury tubes for the voltages employed in sign practice. The back carries transformer ratings.

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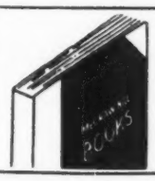

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LETTERS TO THE EDITOR

Nitric Acid Formation in Bushings

To the Editor of ELECTRICAL WORD:

About March, 1926, when on a visit to your country, you published a short article of mine regarding tubular post insulators forming nitric acid. As the article in question was quoted in a discussion on insulators, in the November issue of A.I.E.E., and suggestion made that the hollow center should be filled with some insulating compound, here are the facts subsequent to the nine-year-old article.

At various substations using these tubular insulators on 110-kv. air-break switches they caused a lot of trouble with internal flashovers due to forming nitric acid. The expedient was tried of filling them with pothead compounds as recommended by manufacturers. This was costly because of the care required in preheating the porcelain and cooling difficulties involving contraction voids.

Subsequently, when again erected on the substations, the units gave further trouble and also cracked with expansion of compound in hot weather. They were all finally removed from the system and replaced with ordinary pillar type insulators (three in series).

One of the linesmen has copied King Solomon's architectural idea by erecting two of the insulators as pillars at the porchway of his house, where they serve as flower pots. But electrical engineers learned a lot of practical experience from the ignominious failure of the units.

At our Bunnythorpe substation we have 33 porcelain bushings through the brick walls for the outgoing 11,000-volt, three-phase lines. These bushings are similar to the sketch. About six years after erection they began to break down, and some of the rods and broken porcelain bushings were submitted to an analytical chemist, who reported that they all showed strong nitric acid reaction. The bore of the bushings was cleaned and the $\frac{3}{8}$-in. rods replaced with $\frac{3}{4}$-in. diameter rods. Since then we have experienced no further troubles. The 11 kv. is supplied from a 110-kv./11-kv. delta-star-connected 9,000-kva. bank of transformers, with the neutral solidly ground on 11-kv. side.

W. A. WATERS,
Manawatu-Orua Electric Power Board,
Palmerston, New Zealand.

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An Unemployed Engineer's Viewpoint on Rayburn Bill

To the Editor of ELECTRICAL WORLD:

I was deeply impressed by the National Recovery Number of the ELECTRICAL WORLD. The message it conveys should have far-reaching results.

Unemployed engineers of the country should go to their friends and acquaintances and urge them to write to their Congressmen expressing their opposition to the proposed public utility legislation. These unemployed engineers have an important interest at stake in recovery, for recovery means jobs for them. Moreover, engineers are the ones best qualified to present a true picture of the situation, for they are intimately acquainted with the nature of the problems encountered in keeping service standards at the high level now demanded by the public.

The National Recovery Number of the ELECTRICAL WORLD could be effectively used in such a campaign.

I am one of the many engineers who are unemployed through no fault of their own. In 1932 I was obliged to give up my position and have since been unable to obtain any steady employment.

The majority of people who are opposed to the passage of legislation, such as is contained in the Wheeler-Rayburn bills, fail both to take the trouble to find out how their Congressmen stand and to let their Congressmen know how they stand. In the community where I live I feel certain that I can get many people to write to their Senators and Representatives. I have written, and have already contacted several people, all of whom have promised to write. If the people in the various communities throughout the land could be influenced to make themselves heard the pending bills would undoubtedly be defeated.

In my opinion it would be neither necessary nor advisable to argue with persons or to try to change any one's mind. It would only be necessary to contact those thought to be in sympathy with our cause.

Radio talks, such as Mr. Gadsden's over N.B.C. last Tuesday night (April 9), undoubtedly do a lot of good. However, I fear that a relatively small percentage of the people hear them, even though they are well advertised in the papers. At the risk of appearing presumptuous, I suggest that it might be a good idea for the ELECTRICAL WORLD to urge its readers to be on the lookout for announcements of these broadcasts in the newspapers so that they may tell their friends to listen in.

ALBERT M. GOODNOW,
South Sudbury, Mass.

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Speak Up, Engineers

To the Editor of ELECTRICAL WORLD:

I wish to express my approval and appreciation of the editorial in the ELECTRICAL WORLD entitled "For the Self-Respect of Engineers."

For some time I have been wondering why the strange silence among the engineers, when so much is being done that runs counter to sound engineering judgment and experience. The government is denouncing the waste and losses incurred or caused by the utilities and at the same time it is recklessly squandering the taxpayers' money on uneconomical and even fantastic projects. Not even a hard-boiled stock promoter would have the effrontery to try to sell engraved paper based on the security of some of the undertakings, like navigation improvements on the Missouri and other rivers.

When the Engineering Council was organized I was under the impression that its function was to represent the engineers in public affairs. Has it, too, gone into innocuous desuetude.

C. M. JANSKY,
Madison, Wis.

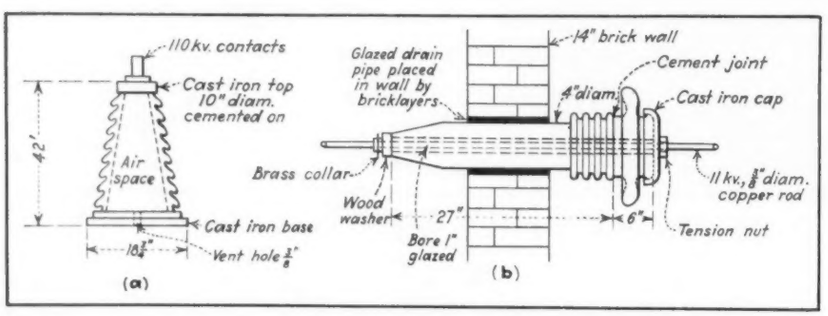
•

Northwest Town Without Any Chimneys

To the Editor of ELECTRICAL WORLD:

I am in receipt this date of the February 16 copy of ELECTRICAL WORLD, in which I note on page 24 reference to a "Northwest Town Without Any Chimneys." It is to be noted that reference to this town as Mason City, Ore., is strictly an injustice to the State of Washington as this town is located in Okanogan County, Washington. Will you please rectify this error in a future number of your magazine?

P. R. NALDER,
U. S. Dept. of the Interior,
Bureau of Reclamation,
Almira, Wash.



110-kv. insulator and 11-kv. bushing in which nitric acid formed in air space
Replacement of $\frac{3}{8}$-in. rod with $\frac{3}{4}$-in. rod in bushing stopped formation of nitric acid

What IS the Life of WEATHERPROOF WIRE* ?

PEERLESS
WEATHERPROOF WIRE

alone has a braid enclosed covering of unspun cotton. The fine fibre structure of this unspun cotton holds the pure air blown asphalt saturant against all assaults of weathering . . . What double or triple braided wire could compare with the Peerless performance pictured here?

An Exclusive Product of

GENERAL CABLE CORPORATION

420 LEXINGTON AVE., NEW YORK

Sales Offices:
ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI
CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK
PHILADELPHIA • PITTSBURGH • ROME • SAN FRANCISCO • ST. LOUIS
SEATTLE • WASHINGTON, D.C.

** For Peerless, the colored yarn annual marker makes the record accurate beyond question.*

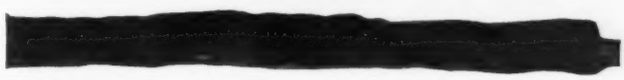
13 YEARS **PEERLESS CASE No. 1.** Wire was taken from a line after 13 years of service. Note the outer braid is still intact.

15 YEARS **PEERLESS CASE No. 2.** Taken from a location where salt air and climatic conditions are severe. The outer braid is still in good condition.

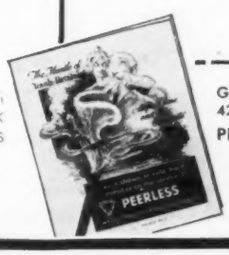
18 YEARS **PEERLESS CASE No. 3.** Also taken from a location having severe climatic conditions. Despite the fact that the braid has disappeared, the covering of unspun cotton remained intact, proof of the long life of Peerless.

18 YEARS **PEERLESS CASE No. 4.** Wind and weather destroyed the braid, but again the unspun cotton has held the saturant uniformly in place. No migration of saturant, no festooning of covering.

21 YEARS **PEERLESS CASE No. 5.** This wire was in service 19 years, followed by two years of test weathering—a total of 21 years in operation. The unspun cotton covering is still in perfect condition.

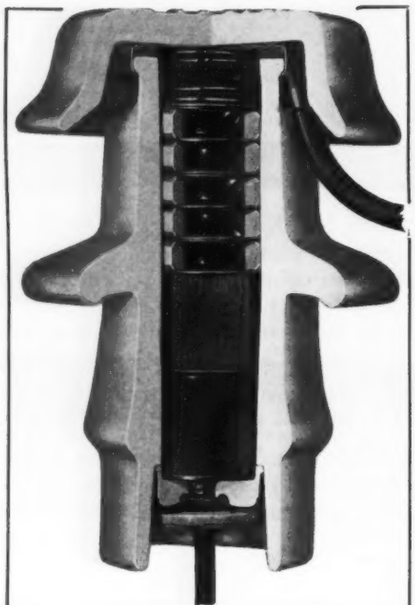


24 YEARS **PEERLESS CASE No. 6.** After 24 years of life, the unspun cotton covering is just starting to disintegrate, but still shows no festoons.



GENERAL CABLE CORPORATION
420 LEXINGTON AVE., NEW YORK
Please send me your bulletin on Peerless Weatherproof Wire.

Name & Address _____



LONGER LIFE

You can expect . . . and get . . . longer life from the new Westinghouse LV Autovalve Arresters, due to two important improvements.

1. The thickness of the block has been increased 50 percent . . . thus it is able to withstand surge currents of 50,000 amperes, far in excess of existing arresters.

2. The crest and cut-off voltages have been increased 15 to 20 percent. The new crest voltage is still below the value necessary to adequately protect the transformer. The cutoff voltage is high enough so that abnormal maintained voltages cannot harm the arrester.

These features . . . only two of the many outstanding advantages of the Westinghouse arresters . . . are explained in detail in Catalog 38 which can be obtained from Westinghouse, Room 2-N, East Pittsburgh, Pennsylvania.

R 54005

Westinghouse

New LV ARRESTERS

Recent Rate Changes

Toledo Edison Company and the City Council have reached a compromise whereby rates under the inflation clause in the new five-year contract can be revised every year. The company agrees to cut domestic rates 22 per cent and street lighting rates 20 per cent under the agreement. Loss in revenue will amount approximately to $500,000 annually. The company sought protection in the event of a drastic change in the value of the dollar during the present monetary uncertainty.

•

California Oregon Power Company valuation and rate investigation case has been ordered closed by Frank C. McColloch, state public utilities commissioner. The order found that "the continued expenditure of large sums of money for this investigation under present economic conditions is against the public interest." The investigation, which was not quite half completed, was begun by the present commissioner's predecessor and had already cost the company $70,000 and the state $50,000. Investigation of the Mountain States Power Company, being well along toward completion, will be continued, Mr. McColloch said.

•

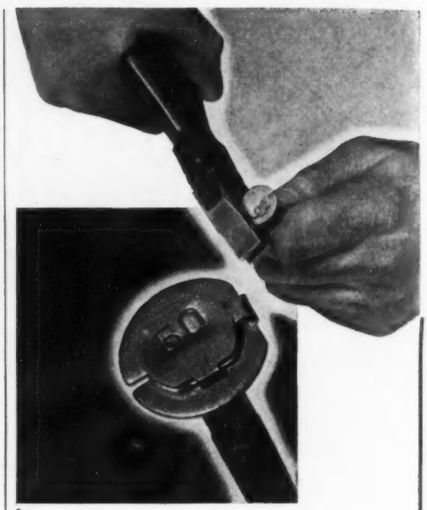
Georgia Power Company, opposing a further downward revision of its commercial electric rates, has filed an answer to the state Public Service Commission, claiming a revenue loss of $2,575,000 in rate reductions during the past eighteen months. The company submitted its answer to a rule *nisi* (ELECTRICAL WORLD, April 13, page 78). Officials of the Savannah Electric & Power Company told the commission that rate reductions put into effect by the commission had cost the company $56,000 in 1934 and that the utility could not withstand a further slash in rates.

•

Pennsylvania Electric Company, serving thirteen western Pennsylvania counties, has filed a reduction in rates with the state Public Service Commission which will save consumers $191,000 a year. The new rates are effective May 1.

•

Public Service Electric & Gas Company in a brief filed last week with the state Board of Public Utility Commissioners contends that its rates are not unjust or unreasonable and "further submits that the company is earning at the present time a sum less than a fair return upon the value of its property devoted to the public use, and will in the future, with the known increase in operating cost confronting the company, earn even less." The brief centers much of its attack upon the testimony and qualifications of the principal witnesses for the petitioners. The decision of the com-



fits ANY fuse holder

Type UT fuse links completely satisfy the fusing requirements of all distribution cut-outs—open or enclosed, standard or drop-out—rated up to 15 Kv. inclusive. The exclusive combination head permits its use with screw-type fuse holders, or with ¾ or ½-inch fuse tube heads.

Other features of Westinghouse Universal Fuse Links are:

1 Split-second operation clears harmful faults before feeder relays operate.

2 26-inch length insures fit in even drop-out type of cutout.

3 Unusual tensile strength—fuse element is paralleled by high-resistance strain wire.

4 Clears low currents not readily interrupted on circuits having severe characteristics.

5 Low temperature operation minimizes possible damage to fuse tubes.

Write Westinghouse, Room 2-N, East Pittsburgh, Pennsylvania for complete information.

R54009

Westinghouse

UNIVERSAL FUSE LINK

mission, after hearings which have lasted nearly two years, is expected in the near future.

•

Kentucky Utilities Company has announced a reduction in electric rates averaging 11.4 per cent in 134 communities, effective May 1. The aggregate saving to customers will total $60,000.

•

Illinois Northern Utilities Company has been ordered by the state Commerce Commission to reduce its electric residential rates $100,000 annually, effective April 16. A second reduction of $20,000 annually starts April 16, 1936, and another April 16, 1937, of $31,000, and still another on January 1, 1938, of $44,000, making a total of $195,000.

•

Illinois Power & Light Company has been ordered by the state Commerce Commission to reduce rates in 43 communities $425,000 annually. Of this reduction approximately $275,000 is to residential customers, with the balance affecting commercial users.

•

Rhode Island electric utility companies have voluntarily reduced rates $450,000 a year. The companies include the Narragansett Electric Company, the Blackstone Valley Gas & Electric Company and the Newport Electric Corporation.

•

Indiana Service Corporation has reduced electric rates in 84 cities and towns with the approval of the state Public Service Commission. Approximately 8,000 customers will share in the reduction, which will amount to approximately $30,000 a year.

•

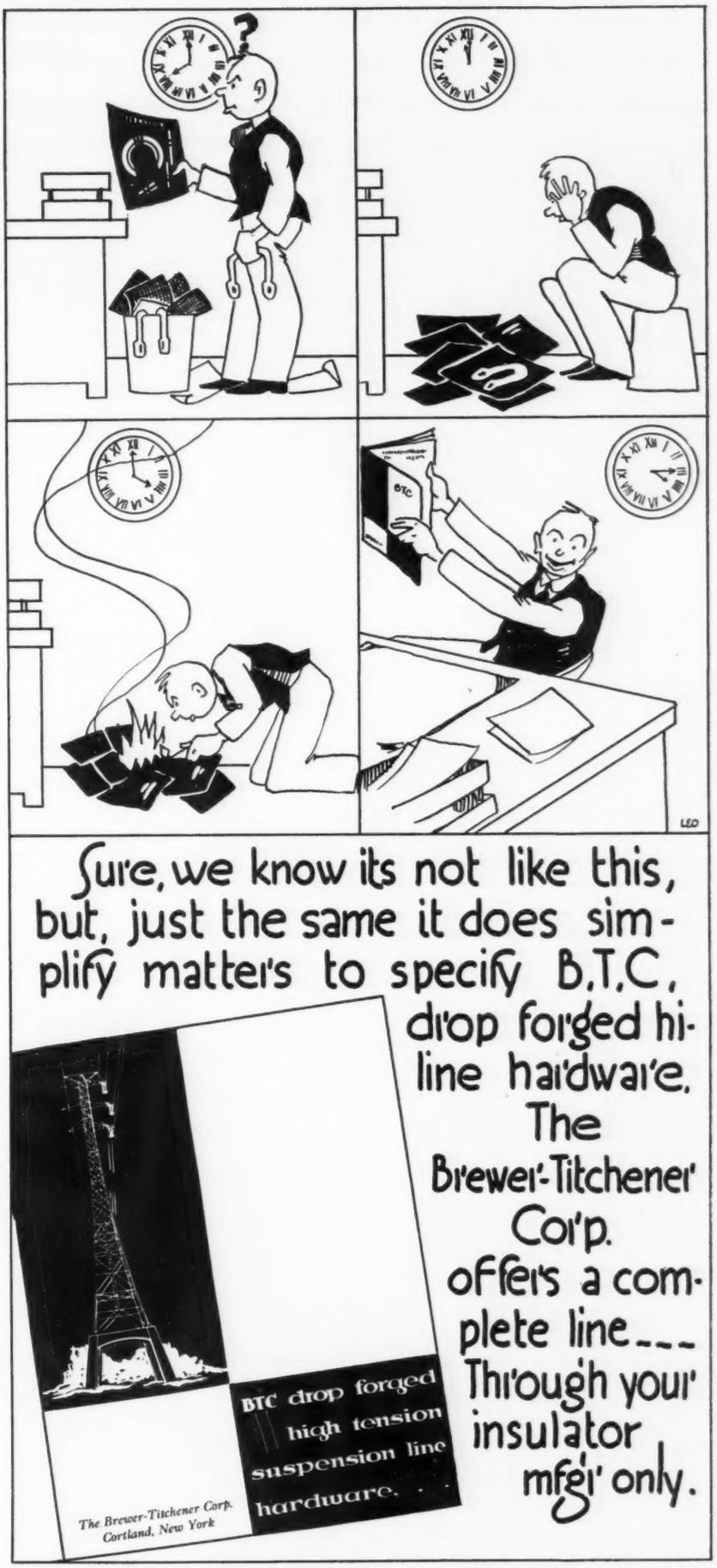
Niagara, Lockport & Ontario Power Company's new rate schedule (ELECTRICAL WORLD, March 2, page 87) has been approved by the New York Public Service Commission. Savings to consumers total approximately $121,000 annually.

•

Empire Gas & Electric Company's new rate schedules have been approved by the New York Public Service Commission. The new schedule will save consumers approximately $116,000. The company has agreed to make a further reduction effective, Jan. 1, 1936, which will save consumers an additional $82,000 annually.

•

New England Power Association affiliate companies have filed with the Massachusetts Public Utilities Commission new schedule of rates effective April 1, which will save domestic and commercial users an aggregate of $355,000 a year. The companies are: Central Massachusetts Electric, Fall River Electric, Amesbury Electric, Milford Electric Light & Power, Malden Electric, Suburban Gas & Electric, Beverly Gas & Electric, Salem Electric and Fitchburg Gas & Electric.


BTC
LEO
Sure, we know its not like this, but, just the same it does simplify matters to specify B.T.C. drop forged hi-line hardware. The Brewer-Titchener Corp. offers a complete line--- Through your insulator mfgr. only.
BTC drop forged high tension suspension line hardware. . .
The Brewer-Titchener Corp.
Cortland, New York

When planning for plant expansion--

—plan for safe and sure fire protection

Be prepared to snuff out fire as quickly as the candle snuffer does the job—by the dry and harmless Lux system. An integral part of your industry the Lux system has been developed to meet the peculiarly rigid demands of modern power hazards.

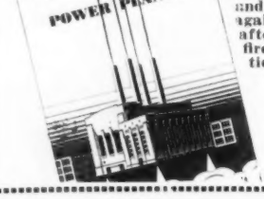
Fire in generators, rotary converters, frequency changers, oil switches or transformers is smothered in ten seconds by Lux carbon dioxide gas. This clean, penetrating gas is a non-conductor — it is absolutely harmless and leaves no trace after use.

With Lux there is no costly shutdown after fire—no chemical or wetting damage. Because Lux gas is non-freezing and good until used, maintenance costs are eliminated.

Approved by Underwriters' Laboratories

TESTED IN SERVICE

The **LUX** SYSTEM



Use coupon below in sending for the Lux Booklet which explains how the Lux system protects plants and substations against costly after-effects of fire, service tie-ups, etc.

Walter Kidde & Company
59 West St., Bloomfield, N. J.

Kindly send me (without obligation) your new booklet "Smothering Fire in Power Plants."

Name .....

Position .....

Company .....

Address .....

SALES OPPORTUNITIES IN NEW CONSTRUCTION

GRUNDY, VA.—Appalachian Electric Power Company, Roanoke, Va., plans extensions in transmission lines in Tazewell-Buchanan-Grundy districts, including new 33,000-volt line between Grundy and Coal Creek, about 20 miles, new line to Richlands, with power substation facilities and local distribution lines for service in territory noted. Cost about $125,000.

BROOKLYN, N. Y.—Signal Supply Officer, Signal Corps, Army Base, asks bids until May 6 for 24 to 36 miles of rubber-jacketed submarine cable (Circular 115). Also, at same time, for 73,000 ft. telephone cable and 39 reels (Circular 118).

TOLEDO, OHIO — Libbey-Owens-Ford Glass Company, Nicholas Building, plans installation of motors and controls, regulators, conveyors and other equipment for expansion and improvements in sheet glass and safety glass plants at Rossford, near Toledo, Shreveport, La., Ottawa, Ill., and Charleston, W. Va. Fund of $1,700,000 authorized for entire project.

LANSING, MICH.—Olds Motor Works and Fisher Body Company, both subsidiaries of General Motors Corporation, Detroit, Mich., plan installation of motors and controls, conveyors and other electrical equipment for expansion in plants. Adjoining property, formerly held by Durant Motors Corporation, comprising group of buildings on 48-acre tract of land, has been acquired and will be equipped for Fisher unit. Cost over $500,000.

TAYLOR, NEB.—Almeria Public Power & Irrigation District, care of Howard Cole, Taylor, recently organized, has had plans approved by State Engineer for hydro-electric power plant and transmission lines in connection with proposed irrigation system.

AURORA, ILL. — Is considering improved street-lighting system in business district, estimated to cost $90,000; also, whiteway lighting system for State highways passing through city, estimated to cost $120,000. Financing will be arranged through federal aid. Walter E. Deuchler is city engineer.

NEW YORK, N. Y.—Jacob Ruppert Brewery, 1639 Third Avenue, has purchased former Ehret Brewery on adjoining site, totaling about two square city blocks, and will remodel and equip for expansion. Cost about $750,000, with equipment.

BRYSON CITY, N. C.—Nantahala Power & Light Company plans extension in transmission lines from Cashiers, N. C., to Lake Sapphire and vicinity, with power substation facilities and distribution lines for service in last noted district. Cost about $60,000.

BOSTON, MASS.—Quartermaster Depot, Army Base, asks bids until May 10 for one motor analyzer, one 6,000-lb. electric lift, air compressor and other equipment (Circular 110).

ANDERSON, IND.—Greer Steel Company, Dover, Ohio, will install heavy-duty motors and controls, electric hoists, conveyors, electric crane, etc., in new strip steel mill at Anderson, consisting of four or more one-story units, for which superstructure will begin soon. Cost about $500,000. R. W. Shoemaker, Anderson, will be in charge of erection.

NOONAN, N. D.—Baukol-Noonan Lignite Coal Company, Noonan, plans electric power plant at coal-mining properties, about one mile from town for service at mines. Also, plans transmission line to town, with power

INVESTIGATE THESE LITTELFUSE PRODUCTS

Tattelite Neon Tester—Tests for blown fuses, open circuits, live lines. Indicates whether AC or DC, polarity, radio frequency or static.

Ded-Fuse Tattelite—"Tells the Tale"—which fuse is blown. Easily attached on any fuse mounting. Operates only after fuse has blown.

Surge and Lightning Protector—Neon Tattelites bypass surges—in D. C. Magnets, Solenoids, Shunt and Compound Motors, etc.

Instrument Littelfuses—Low range precision fuses possessing stable time current characteristics for protecting galvanometers, instruments, test sets, etc., 1/200 amp. up. Send for bulletin.

High Voltage Littelfuses—For low amperage high voltage service — accurate and dependable — ratings up to 10,000 volts.

Write for Descriptive Literature.

LITTELFUSE LABORATORIES
Ravenswood and Sunnyside Avenues,
CHICAGO, ILL.

SPLICING SLEEVES

THOROUGHLY RELIABLE AND EASILY HANDLED

Wolverine Copper Splicing Sleeves are all made by the extrusion method which leaves a perfectly smooth surface inside the barrel.

Specify Wolverine Sleeves for quicker installation.

WOLVERINE TUBE COMPANY

1441 Central Ave., Detroit, Mich.

Stocks in All Principal Cities

substation and electrical distribution system for municipality. Franchise is being secured.

SHEFFIELD, ALA.—Plans early call for bids for electrical distribution system, for which fund of $230,000 has been secured through federal aid.

ATLANTA, GA.—Warren Company, Fair Street, plans installation of motors and controls, conveyors, etc., in connection with rebuilding of portion of refrigerator-manufacturing plant, recently destroyed by fire. Loss about $100,000.

HUTCHINSON, MINN.—Has authorized bond issue of $250,000 for new city-owned electric light and power plant, and will have plans drawn soon. E. G. Briggs, 1955 University Avenue, St. Paul, Minn., is consulting engineer.

MIDWAY, KY.—Ralph Greenbaum & Company, Inc., Frankfort, Ky., distiller, plans new multi-unit plant on site of former J. S. Greenbaum Distillery, Midway, including power house. Cost over $100,000. Carl J. Kiefer, Schmidt Building, Cincinnati, Ohio, is consulting engineer.

SAN DIEGO, CALIF.—Consolidated Aircraft Corporation, Buffalo, N. Y., plans installation of motors and controls, conveyors, electric hoists and other equipment in new plant on 22-acre tract of land at Lindbergh airfield, San Diego, for airplane and flying boat-manufacture. Initial units will total 300 x 900 ft. Cost about $500,000.

CRYSTAL CITY, MO.—Pittsburgh Plate Glass Company, Grant Building, Pittsburgh, Pa., plans installation of motors and controls, regulators, power substation equipment, conveyors, etc., for expansion in safety glass manufacturing plant at Crystal City. Cost over $850,000. Company has authorized total fund of $1,900,000 for this and other sheet and safety glass plant extensions.

WASHINGTON, D. C.—Bureau of Supplies and Accounts, Navy Department, asks bids until May 3 for quantity of searchlights (Schedule 4675); until May 7 for quantity of electric cable (Schedule 4848) and for two automatic generator voltage regulators (Schedule 4843), all for Eastern and Western Navy Yards. Until May 10 for 16 electric searchlights and spare parts for Mare Island, Calif., Navy Yard (Schedule 4871).

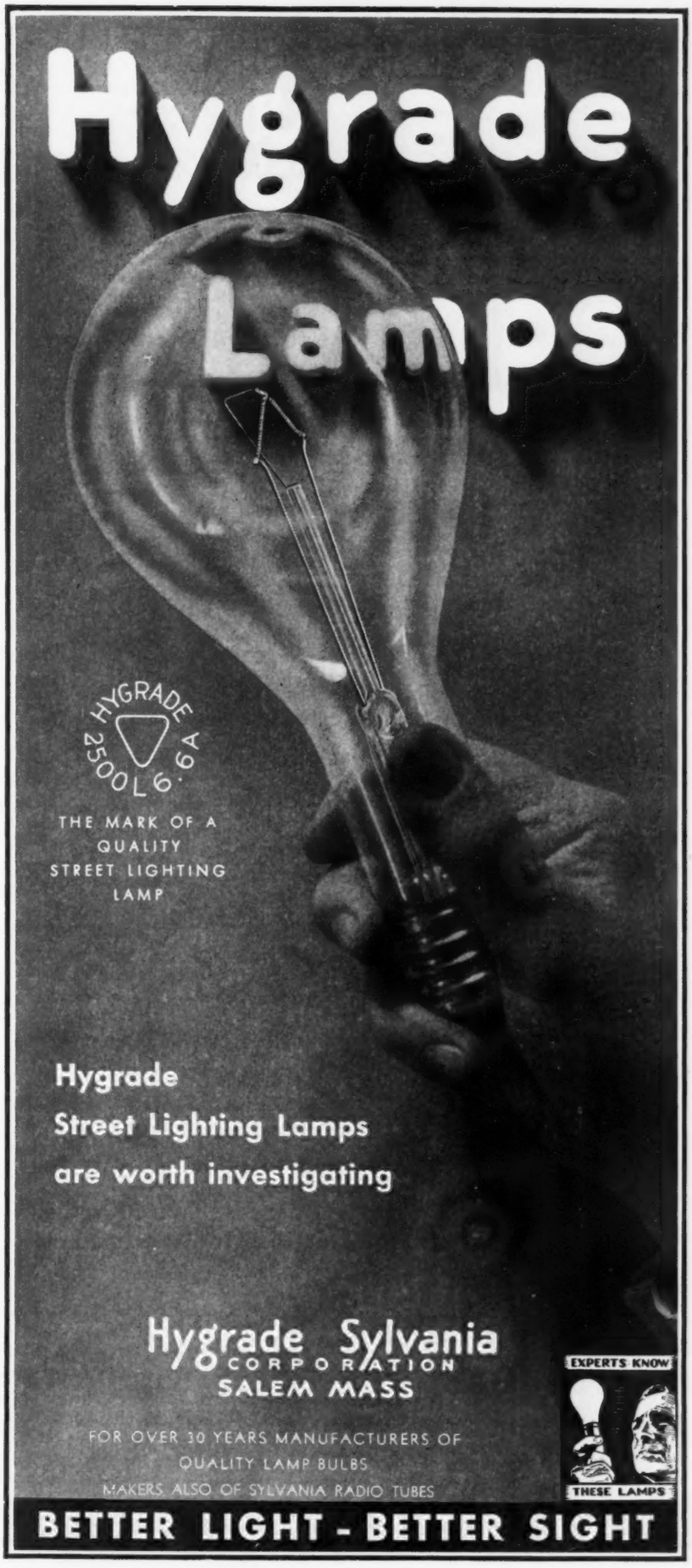
SAVANNAH, GA.—Union Bag & Paper Corporation, Woolworth Building, New York, N. Y., plans power plant at proposed new multi-unit pulp and paper mill, and paper-converting plant at Savannah, where site is being selected. Will install motors and controls, electric hoists, conveyors, etc., for mill service. Entire project estimated to cost in excess of $3,500,000.

ST. LOUIS, MO.—Chevrolet Motor Company, Detroit, Mich., plans installation of motors and controls, conveyors, electric hoists, etc., in new addition to branch assembling works at St. Louis. Cost about $110,000. Albert Kahn, Inc., New Center Building, Detroit, is architect.

DENVER, COLO.—Bureau of Reclamation, Denver, asks bids until May 2 for one hydraulic control board for installation in control room, and for position transmitters for needle-valve position indicators, Boulder power plant, Boulder Canyon, Arizona - California - Nevada (Specification 675-D).

HAMMOND, LA.—Hammond Box Company plans installation of motors and controls, conveyors, etc., in connection with proposed rebuilding of box and crate-manufacturing plant, recently destroyed by fire. Loss over $150,000.

CHICAGO, ILL.—Armour & Company, Union Stock Yards, plans installation of motors and controls, elevators, conveyors, electric hoists and other equipment in new six-story abattoir and meat plant, 102x238 ft. Cost about $750,000.



POLES PILING

Weyerhaeuser

POLES

Mark the Path of Progress

Social and economic growth inevitably follow as electric power and communication lines push ever deeper into new frontiers. Weyerhaeuser red cedar poles have long played an important role in this advance.

Grown to their prime in Weyerhaeuser's West Coast forests, these poles are carefully selected, expertly cut, seasoned and prepared for their vital part in the march of progress.

And today you'll find Weyerhaeuser poles marking America's progress toward economic recovery.

If the selection of good poles is your responsibility, write for your copy of the practical Weyerhaeuser pole manual. It's a useful reference.

WEYERHAEUSER POLE COMPANY

Rand Tower · Minneapolis · Minnesota

Represented by

WESTINGHOUSE ELECTRIC SUPPLY COMPANY

Canadian Plants Have 7,500,000 Hp.

Water-power resources of the Dominion of Canada as at present recorded will permit of a turbine installation of about 43,700,000 hp., according to a report by the Dominion Water Power and Hydrometric Bureau. Actual installations at the end of 1934 totaled 7,547,035 hp., which indicates that only 17¼ per cent of the available power has been developed.

Compared with the population, estimated at 10,835,000 as of June 1, 1934, power developments are equivalent to 0.697 hp. per capita. For Quebec province this rises to 1.225 hp.

Present installations in turbine horsepower are as follows:

British Columbia ..	717,717	New Brunswick ...	133,681
Alberta ...	71,597	Nova Scotia ..	116,367
Saskatchewan	42,035	P.E. Island	2,439
Manitoba .	390,925	Yukon and N. W. Terr. ...	13,199
Ontario ...	2,355,755		
Quebec ...	3,703,320	Canada ..	7,547,035

All but one-eighth of the total is in central electric stations. These comprise 6,589,941 hp.; pulp and paper mills have 605,346 hp., and other industries 351,748 hp.

Nearly all of this development has taken place since 1900. At the end of that year the total water-power installation was only 173,323 hp. Growth during the decade beginning with 1924 has been quite uniform at the rate of nearly 400,000 hp. annually, although last year it was only 214,965 hp.

•

Electric Storage Battery Earns $2.21

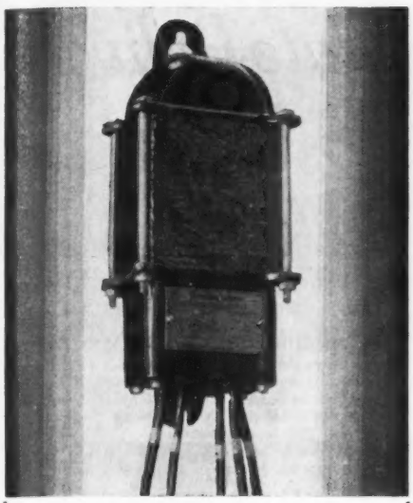
For the year 1934 the Electric Storage Battery Company and Willard Storage Battery Company report net income after depreciation, federal taxes and other charges, totaling $2,004,404, equal to $2.21 a share on 907,810 combined common and preferred shares, against $2,022,206, or $2.23 a combined common and preferred share, in 1933.

•

General Electric Announces Architectural Awards

Architectural firms in Cleveland and Chicago shared the two grand prizes and architects in New York carried off the two first awards in the home electric architectural competition sponsored by the General Electric Company in cooperation with the Federal Housing Administration. The contest opened January 1, continued ten weeks and more than 2,000 sets of plans were submitted from every state in the country. A total of $21,000 was awarded in 52 prizes.

The two grand prizes, each for $2,500, were awarded to Hays & Simpson of Cleveland and to Paul Schweikher and



REDUCE LIGHT FLICKER

Objectionable flicker caused by the starting of motors or domestic appliances can be reduced as much as 60 per cent by Westinghouse Type "J" Auto-Transformers. In fact, their installation often results in a greater improvement in service than would be possible with a two or three hundred per cent increase in investment for secondary copper.

These low-cost transformers can be used for any type of approved wiring, are easily installed, and require little space.

The shell-type of construction used gives maximum support for the coils and offers the greatest resistance to forces developed by short circuits.

For complete information address Westinghouse, Room 2-N, East Pittsburgh, Penna.

R 59009

Westinghouse

DRY TYPE TRANSFORMERS

Theodore Warren Lamb of Chicago. The two first prizes, each for $1,500, were awarded to Stephen J. Alling, a young architect who finished his studies at the Massachusetts Institute of Technology but a year and a half ago, and to J. André Fouilhoux and Don E. Hatch, jointly, both of New York.

•

Range Sales Doubled

Sales of electric ranges nearly doubled in the first two months of 1935 compared with 1934. Based on reports of 11 identical companies, the National Electrical Manufacturers' Association has announced the following number of units sold:

	1934	1935
January	3,611	6,606
February	5,575	11,013

Total sales in 1934 more than doubled those in 1933, being 122,817 units against 51,828 units. These totals are only approximately comparable because two of the smaller companies did not report during the earlier part of 1933. Figures for the last five months of each year are, however, on an identical basis and show a gain of 69 per cent.

•

Arrow-Hart & Hegeman Net Totals $254,927

Report of Arrow-Hart & Hegeman Electric Company for the year ended December 31, 1934, shows net income of $254,927 after taxes, charges, depreciation, etc., equivalent, after dividend requirements on 6½ per cent cumulative preferred stock, to 75 cents a share (par $10) on 200,000 shares of common stock. This compares with $17,288, or 1.06 a share, on 16,206 shares of preferred stock, excluding 4,877 shares in the treasury in 1933.

•

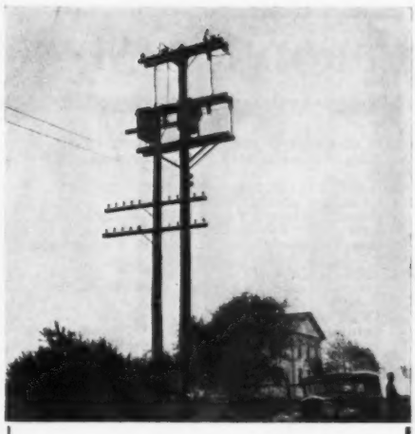
Air-Conditioning Sales Up

Sales volume of the air-conditioning division of the Frigidaire Corporation, a subsidiary of the General Motors Corporation, was 302 per cent higher in February than in February a year ago, J. J. Nance, manager, announced last week.

•

Anaconda Wire Profit

Net profit of the Anaconda Wire & Cable Company after expenses, depreciation and taxes, was $821,802 for 1934, against a net loss of $213,872 for 1933. Profits on manufacturing operations increased to $2,535,183 from $1,290,037. Current assets as of December 31, including $180,191 in cash, amounted to $6,639,977, and current liabilities were $1,067,933. As a result of the profit for the year the deficit in surplus was reduced to $1,702,846 from $2,599,233.



keep
RURAL VOLTAGE
up

Low voltage on rural lines, with its resultant loss of revenue and customer good will, can now be prevented at low cost.

The Westinghouse type BR Booster, a simple, reliable, low-cost device, has proved conclusively that it economically maintains a reasonably normal voltage . . . even during periods of peak demand.

Easily and quickly installed . . . requiring only a small initial investment . . . and needing practically no attention or maintenance . . . this automatically-controlled booster will pay for itself in a surprisingly short time through increased revenue and the stimulated use of load-building equipment.

•

Write Westinghouse, Room 2-N, East Pittsburgh, Pa. for complete information.

R 59005

Westinghouse

The New BR BOOSTER

PRODUCT INDEX

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

AIR-CONDITIONING EQUIPMENT
Frigidaire Corp., Dayton, Ohio.
General Electric Co., Schenectady, N. Y.
Kelvinator Corp., Detroit, Mich.
Westinghouse E. & M. Co., E. Pittsburgh, Pa.

ALLOYS, NICKEL
International Nickel Co., New York, N. Y.

AMMETER, CLIP-ON
Columbia Elec. Mfg. Co., Cleveland, Ohio
Ferranti, Inc., New York, N. Y.

ANALYSES, REVENUE
Recording & Statistical Corp., New York, N. Y.

ANCHORS, GUY
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Everstick Anchor Co., Fairfield, Iowa.
Hubbard & Co., Pittsburgh, Pa.
Kearney Corp., James R., St. Louis, Mo.
Line Material Co., South Milwaukee, Wis.

APPLIANCES, HEATING
General Electric Co., Schenectady, N. Y.
Graybar Electric Co., New York, N. Y.

BATTERIES, STORAGE, ALL APPLICATIONS
Electric Storage Battery Co., Phila., Pa.
Gould Storage Battery Co., Depew, N. Y.
USL Battery Corp., Niagara Falls, N. Y.

BATTERIES, STORAGE, AUTOMOTIVE
Firestone Tire & Rubber Co., Akron, Ohio.
USL Battery Corp., Niagara Falls, N. Y.

BATTERY CHARGING APPARATUS
General Electric Co., Schenectady, N. Y.

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Western Block Co., Lockport, N. Y.

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States Company, Hartford, Conn.

BOILERS, STEAM
Babcock & Wilcox Co., New York, N. Y.
Combustion Engineering Co., New York, N. Y.

BOXES, FUSE
G & W Elec. Specialty Co., Chicago, Ill.
General Electric Co., Bridgeport, Conn.

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Hubbard & Co., Pittsburgh, Pa.

BRACKETS & WIREHOLDERS, INSULATED
Hubbard & Co., Pittsburgh, Pa.

BRUSHES, CARBON
National Carbon Co., Cleveland, Ohio.

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Babcock & Wilcox Co., New York, N. Y.
Combusion Engineering Co., New York, N. Y.

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General Electric Co., Schenectady, N. Y.
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Aluminum Co. of America, Pittsburgh, Pa.
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American Steel & Wire Co., Chicago, Ill.
Rockbestos Products Corp., New Haven, Conn.

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American Elec'l Works, Phillipsdale, R. I.
American Steel & Wire Co., Chicago, Ill.
Anaconda Wire & Cable Co., New York, N. Y.
General Cable Corp., New York, N. Y.
Kerite Ins. Wire & Cable Co., New York, N. Y.
Okonite-Callender Cable Co., Passaic, N. J.
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Anaconda Wire & Cable Co., New York, N. Y.
Crescent Ins. Wire & Cable Co., Trenton, N. J.
General Cable Corp., New York, N. Y.
Okonite Co., Passaic, N. J.
Phelps-Dodge Copper Products Co., New York
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Simplex Wire & Cable Co., Boston, Mass.

CABLE, STEEL STRAND
American Steel & Wire Co., Chicago, Ill.
Indiana Steel & Wire Co., Muncie, Ind.
Roebling's Sons Co., J. A., Trenton, N. J.

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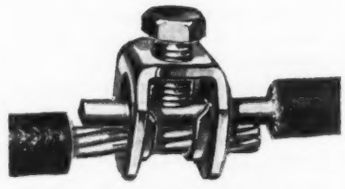

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